Fairview Beach Watershed Plan
King George County, Virginia

Prepared for
Virginia Department of Environmental Quality (DEQ)
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Cover Photo

Potomac River at Fairview Beach, Virginia, May 15, 2014. Photo by James Palmer, ICPRB.

Disclaimer

The opinions expressed in this report are those of the authors and should not be construed as representing the opinions or policies of the United States government or the signatories or Commissioners to ICPRB.

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Abbreviations

ARA	Antibiotic Resistance Analysis
BMP	Best Management Practice
CBPA	Chesapeake Bay Preservation Act
COG	Metropolitan Washington Council of Governments
CSS	Combined Sewer System
CWA	Clean Water Act
CWG	Community Working Group
DCR	Virginia Department of Conservation and Recreation
DEM	Digital Elevation Model
DEQ	Virginia Department of Environmental Quality
DEQ-NRO	Virginia Department of Environmental Quality - Northern Regional Office
DSS	Virginia Department of Health Division of Shellfish and Sanitation
EPA	United States Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FBRA	Fairview Beach Residents Association
FWAs	Fluorescent Whitening Agents
GIS	Geographic Information Systems
GWG	Government Working Group
ICPRB	Interstate Commission on the Potomac River Basin
KGSA	King George County Service Authority
LTCP	Long-Term Control Plan
MD DNR	Maryland Department of Natural Resources
MST	Microbial Source Tracking
NFWF	National Fish and Wildlife Foundation
N/A	Not Applicable
NHD	National Hydrography Dataset
NRCS	Natural Resources Conservation Service
OB	Optical Brightener
P532	Phase 5.3.2
PSA	Primary Settlement Area
SERCAP	Southeast Rural Community Assistance Project, Incorporated
SC	Steering Committee
SWCD	Soil and Water Conservation District
TCCSWCD	Tri-County/City Soil and Water Conservation District
TMDL	Total Maximum Daily Load
TNTC	Too Numerous to Count
U.S.	United States
VCAP	Virginia Conservation Assistance Program
VCE	Virginia Cooperative Extension
VDACS	Virginia Department of Agriculture and Consumer Services
VDGIF	Virginia Department of Game and Inland Fisheries
VDH	Virginia Department of Health
VDOF	Virginia Department of Forestry
VDOT	Virginia Department of Transportation

VIMS	Virginia Institute of Marine Science
VMRC	Virginia Marine Resources Commission
VPA	Virginia Pollution Abatement
VPDES	Virginia Pollution Discharge Elimination System
VT	Virginia Polytechnic Institute and State University, "Virginia Tech"
WQIF	Water Quality Improvement Fund

Units of Measurement

acre-ft	Acre-foot
cfu	Colony-forming unit
cfu/acre/yr	Colony-forming units per acre per year
cfu/day	Colony-forming units per day
cfu/g	Colony-forming units per gram
cfu/mg	Colony-forming units per milligram
cfu/ml	Colony-forming units per milliliter
cfu/year	Colony-forming units per year
ft.	Foot
g/d	Grams per day
mgd	Million gallons per day
mi^2	Square mile
ml	Milliliter
sq. ft.	Square foot

Acknowledgements

This plan is the result of the commitment and dedication of concerned community members and diverse organizational interests. Virginia Department of Environmental Quality provided funding and oversight of this project. The careful monitoring by Virginia Department of Health, Virginia Tech, and Fairview Beach Residents Association form the basis of this work. Their efforts were essential to quantifying the necessary load reductions and identifying critical areas for implementation of management measures. The King George County Planning Commission provided a number of geospatial products for use in the development of this plan. The use of King George County's L.E. Smoot Memorial Library meeting space is greatly appreciated. A number of local and national programs were contacted to obtain feasibility and cost information for management practices. Many thanks to all those who provided valuable input, making this plan as practical and implementable as possible. Scientific questions were posed to a number of federal and academic institutions, including the U.S. Geological Survey, Woods Hole Oceanographic Institution, and Virginia Tech, to enhance understanding of the physical processes at work along the sand-water interface. Thank you for the detailed explanations and thoughtful insights.

The enthusiastic participation and timely feedback by the Steering Committee, Government Working Group, and Community Working Group made this plan possible. Specifically, thank you to the following organizations for participating in the working group meetings for the development of the Fairview Beach Watershed Plan. Many thanks also to the numerous concerned citizens, not listed below, who graciously donated their time, local knowledge, and professional expertise.

Fairview Beach Residents Association
King George County Board of Supervisors
King George County Service Authority
Tri-County/City Soil and Water Conservation District
Virginia Department of Health
Virginia Cooperative Extension

Executive Summary

Fairview Beach is a quiet community in King George County, Virginia with the amenity of a privately owned beach on the Potomac River. The beach was placed on Virginia's List of Impaired Waters in 2006 due to elevated bacteria levels. The geography of Fairview Beach, in conjunction with local anthropogenic activities, makes it susceptible to bacteria transport and contamination. Fortunately, management measures are available to address the ongoing problem. This Fairview Beach Watershed Plan describes the approach for addressing the bacteria problem utilizing stakeholder-driven management efforts. The plan follows the nine elements (a through i) described in the U.S. Environmental Protection Agency's (EPA) *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (EPA 2008).

Stakeholder participation was an essential component of the plan's development, **Chapter 3** (element e). Stakeholder input was obtained through informal discussions and formal meetings. The Steering Committee (SC), Government Working Group (GWG), and Community Working Group (CWG) generously donated their time to provide background information; determine the feasibility of management measures; and review the draft plan. Ongoing local and regional participation will be crucial to successful implementation of the plan.

The bacteria problem at Fairview Beach was evaluated to determine the sources of bacteria, the transport mechanisms, and necessary load reductions (**Chapter 4**) (elements a and b). Meeting the water quality standard requires a 73% reduction in *Enterococci* bacteria. Sources of the bacteria include birds, humans, pets, and wildlife. Elevated bacteria levels tend to occur when the water is turbulent, muddy, choppy, or otherwise rough. It is likely that the bacteria re-suspended under these conditions originally derived from local stormwater runoff. An estimated 41% of *Enterococci* under rough conditions is contributed by birds while 27% comes from human sources, 23% from pets, and 9% is attributable to wildlife. Wildlife is the dominant (42%) contributor of *Enterococci* under calm conditions (and for sub-surface flows), with 27% of *Enterococci* associated with human sources, and 15% each attributable to bird and pet sources. The management approach for achieving the 73% reduction is to eliminate human and pet sources of bacteria and to reduce bird and wildlife sources of bacteria in stormwater by 50%.

Chapter 5 describes existing and planned management measures to address the bacteria impairment. Anticipated load reductions, critical areas for implementation (element c), technical assistance needed (element d), necessary permits and review, and the lead agencies are discussed for each measure. Management practices are grouped into five categories for discussion purposes; namely, Best Management Practices (BMPs) to address human sources, BMPs to address pet waste, BMPs to address stormwater, educational activities, and other BMPs. In total, 30 management measures, listed below, are proposed to achieve the water quality standard at Fairview Beach.

BMPs to address human sources

- Improve the sewer system by finding and fixing leaking laterals using dye/smoke testing
- Identify failing septic systems in the trailer park using dye testing
- Ensure that boat pump-out station at marina is maintained in working order
- Collect waste from boats during high traffic times utilizing a pump-out boat
- Pump and close old/unused septic tanks
- Hook up remaining septic users to sewer
- Address flooding drainfields

- Repair workable septic systems
- Pump septic tanks regularly
- Alternative on-site septic systems

BMPs to address pet waste

- Install/maintain pet waste stations
- Pick up pet waste, volunteer or service

BMPs to address stormwater

- Install rain barrels
- Redirect downspouts onto grassy areas
- Install porous pavement
- Encourage low impact development techniques
- Take advantage of redevelopment opportunities in the trailer park area
- Plant vegetative buffers and/or convert turf to trees
- Install rain gardens

Educational activities

- Implement a general education program
- Conduct mailings to the trailer park owner to determine where problems exist
- Conduct a septic maintenance education program, including educational materials and technical advice
- Distribute leash bag holders to pet owners
- Implement a recreational boater education program
- Encourage more inspections of boats by the Coast Guard Auxiliary
- Participate in Virginia Clean Marina Program
- Require records of old septic tanks during property transfer or hook up of system to sewer
- Implement a feral cat population control education program

Other BMPs

- Repair bulkheads and enhance with vegetation
- Increase width of beach by 10-15 yards
- Discourage birds from visiting the beach

The plan's implementation schedule (element f) follows a two-phase approach (**Chapter 6**). Phase 1 will be completed in years one through five. Phase 2 will be completed in years six through ten. The implementation strategy incorporates an adaptive component to evaluate progress at key times. The extent of Phase 2 implementation, for example, will be determined using adaptive decision-making.

Chapter 7 discusses the costs, benefits, and funding sources available for the plan's implementation (element d). The total cost of the plan is approximately $1,177,327. Of this, $910,684 will be expended during Phase 1. The remaining costs are required to complete Phase 2. Additional funds may be needed during Phase 2 depending on the extent of measures necessary to meet the water quality standard.

Interim measureable milestones are defined in **Chapter 8** to determine whether management measures are being implemented as planned (element g). Short-, mid-, and long-term milestones are presented in a check-list format to encourage regular evaluation. There are 15 short-term milestones (years 1 and 2), 13 mid-term milestones (years 3 through 5), and 4 long-term milestones (years 6 through 10). Metrics for measuring BMP implementation progress are also listed. Metrics include, but are not limited to, the number, type, and location of installed stormwater practices; the number of septic systems pumped and closed; and the number of new sewer connections.

Chapter 9 discusses how the Fairview Beach Watershed Plan is integrated with other watershed plans and projects. Integration with other efforts will produce synergistic results.

Chapter 10 establishes criteria for determining progress towards meeting bacteria water quality standard (element h). Environmental and programmatic targets are defined. Environmental targets include interim reductions in bacteria counts and swimming advisories and, ultimately, achieving the water quality standard. Programmatic targets include implementation of proposed BMPs as provided in **Chapter 8**.

A monitoring component is developed in **Chapter 11** to evaluate the effectiveness of implementation efforts over time (element i). Monitoring efforts include Virginia Department of Health (VDH) beach monitoring, citizen wet-weather monitoring, and pre-post BMP monitoring. Ultimately, collected data will be coupled with historic data to assess long-term trends and progress towards the water quality standard.

Utilizing the approach outlined in this document, and adapting it as necessary over time, the projection is that the bacteria impairment can be addressed within ten years.

1 Introduction

Fairview Beach, located on the Potomac River in King George County, Virginia, was placed on Virginia's List of Impaired Waters in 2006. This Fairview Beach Watershed Plan describes the stakeholder-driven approach for addressing the local bacteria problem. The plan follows the nine elements described in EPA's *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (EPA 2008). The decision to address the impairment utilizing a watershed plan approach is documented below followed by a description of the watershed plan elements.

1.1 Selection of a Watershed Plan Approach[1]

Section 303(d) of the Clean Water Act (CWA) and the EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that do not meet water quality standards. EPA regulations and guidance, however, recognize that an impaired water may not need a TMDL if there are other pollution control requirements that are sufficient to meet water quality standards within a reasonable period of time. Waterbodies where an alternative approach can be used instead of a TMDL for addressing an impairment can be classified as Category 4B in contrast to waterbodies requiring TMDLs, which are classified as Category 5 in Virginia's Water Quality Integrated Report.

According to ICPRB (2013), Fairview Beach is a candidate for a Category 4B listing and development of a watershed plan, for the following reasons:

1. The impaired area is very small (0.012 mi^2). Elevated bacteria levels extend no more than 25 yards into the Potomac River. The local drainage area contributing to the swimming area is on the order of one to two mi^2. The control measures and restoration measures needed to address the bacteria impairment are highly specific, and TMDL allocations will not provide any guidance on implementing them.
2. Some control measures, such as pet waste stations, are already in place. The implementation of other control measures, such as structural measures to control beach erosion, are already underway.
3. The highest priority should be given to the identification and elimination of the contribution of human sources (septic systems, faulty sewer connections) to the bacteria impairment. Since there is no legal discharge of these sources, they would receive no allocation under a hypothetical TMDL.

Formally, the justification of a Category 4B listing requires the following six elements (Regis 2006).

1. Identification of segment and statement of the problem causing the impairment;
2. Description of pollution controls and how they will achieve water quality standards;
3. An estimate or projection of the time when water quality standards will be met;
4. Schedule for implementing pollution controls;
5. Monitoring plan to track effectiveness of pollution controls; and
6. Commitment to revise pollution controls, as necessary.

[1] This section is adapted from the version that first appeared in ICPRB (2013) as a justification for a watershed plan approach.

The nine elements of the watershed plan (discussed in the next section) cover the first five elements of the Category 4B listing justification and include some additional elements, like a public information component and interim milestones, which are not essential elements of the justification. The only element of the justification not explicitly addressed by the watershed plan is the commitment to adaptive management. Adaptive management, however, is an important component of the Fairview Beach Watershed Plan.

1.2 Watershed Plan Elements

The EPA (2008) outlines nine key elements for inclusion in a watershed plan, listed below. The Fairview Beach Watershed Plan includes all of these elements. The chapter addressing each element is provided in parenthesis in the list below. In addition to the nine elements, the plan also incorporates adaptive management techniques throughout. A description of how this plan integrates with other watershed plans and projects is also provided (**Chapter 9**). Utilizing this approach, the bacteria impairment at Fairview Beach should be addressed within ten years.

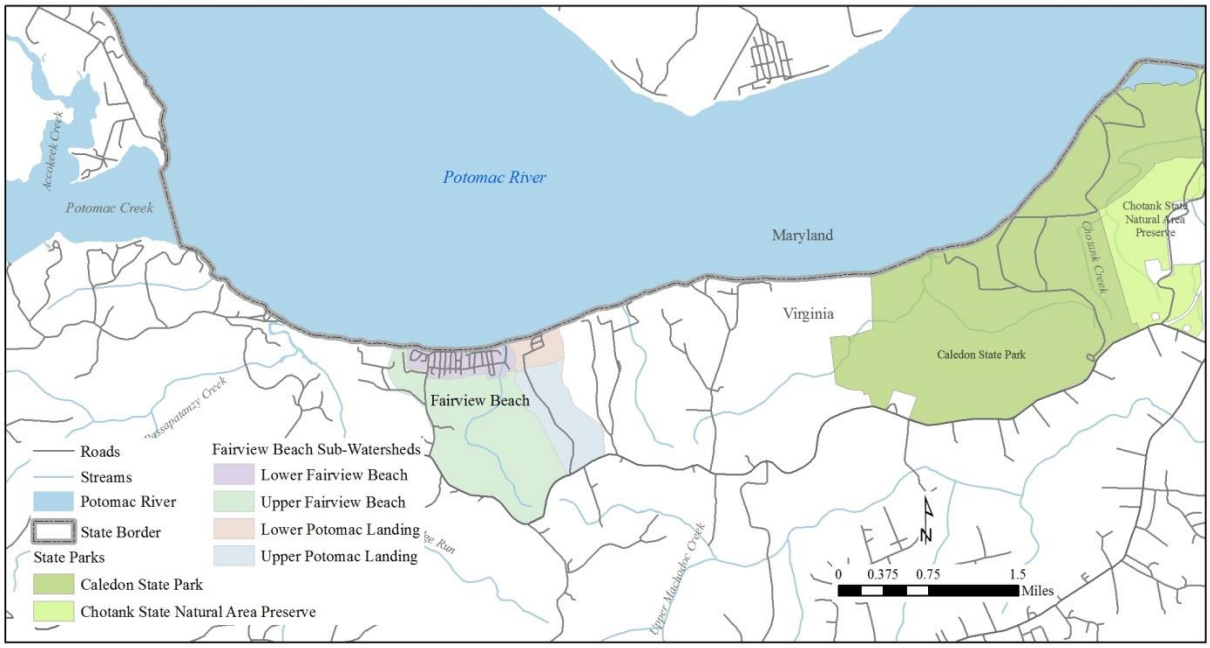
element a) Identification of causes and sources of pollution (**Chapter 4**);
element b) Estimate of load reductions expected from management measures (**Chapter 5**);
element c) Description of management measures to achieve load reductions and of the critical areas in which these need to be implemented (**Chapter 5**);
element d) Estimate of the technical and financial assistance needed to implement plan (**Chapters 5 and 7**);
element e) An information and education component used to enhance public understanding of the project (**Chapter 3**);
element f) Schedule for implementing management measures (**Chapter 6**);
element g) Description of interim measureable milestones to determine whether management measures are being implemented (**Chapter 8**);
element h) Criteria for determining progress towards meeting water quality standards (**Chapter 10**); and
element i) Monitoring component to evaluate effectiveness of implementation efforts over time (**Chapter 11**).

2 Description of Fairview Beach

Fairview Beach is a small beach on the Potomac River in King George County, Virginia. It lies in the Primary Settlement Area (PSA) of Fairview Beach. PSAs are unincorporated areas of King George County where the county provides water and sewer services. **Figure 2-1** shows the location of the PSA of Fairview Beach.

There are approximately 5,750 ft. of shoreline in the plan area, including a designated swimming area about 75 to 100 yards long. All of the shoreline is privately owned, but property owners have access to the shoreline by covenant. Most of the beaches at Fairview Beach are open only to the town's residents, their families and their guests. Numerous boaters utilize the Potomac River waters just off Fairview Beach where the shallow water and sandy bottom, as well as the local restaurants, are popular destinations to anchor one's boat in summer months. Both restaurants have beach areas open to their customers for swimming.

Figure 2-1. Location of Fairview Beach.



2.1 Description of PSA

According to the King George County Comprehensive Plan (King George County 2013), the subdivisions of Fairview Beach were surveyed in the 1920's. The original subdivisions cover only about 100 acres. Most of the homes were constructed in the 1950's as second homes, but even in the 1970's they were already being converted to primary residences (Dewberry, Nealon, and Davis 1974). Average lot size is small, 5,000 to 8,000 sq. ft., and it is estimated that impervious cover accounts for 50-70% of the average lot (King George County 2012).

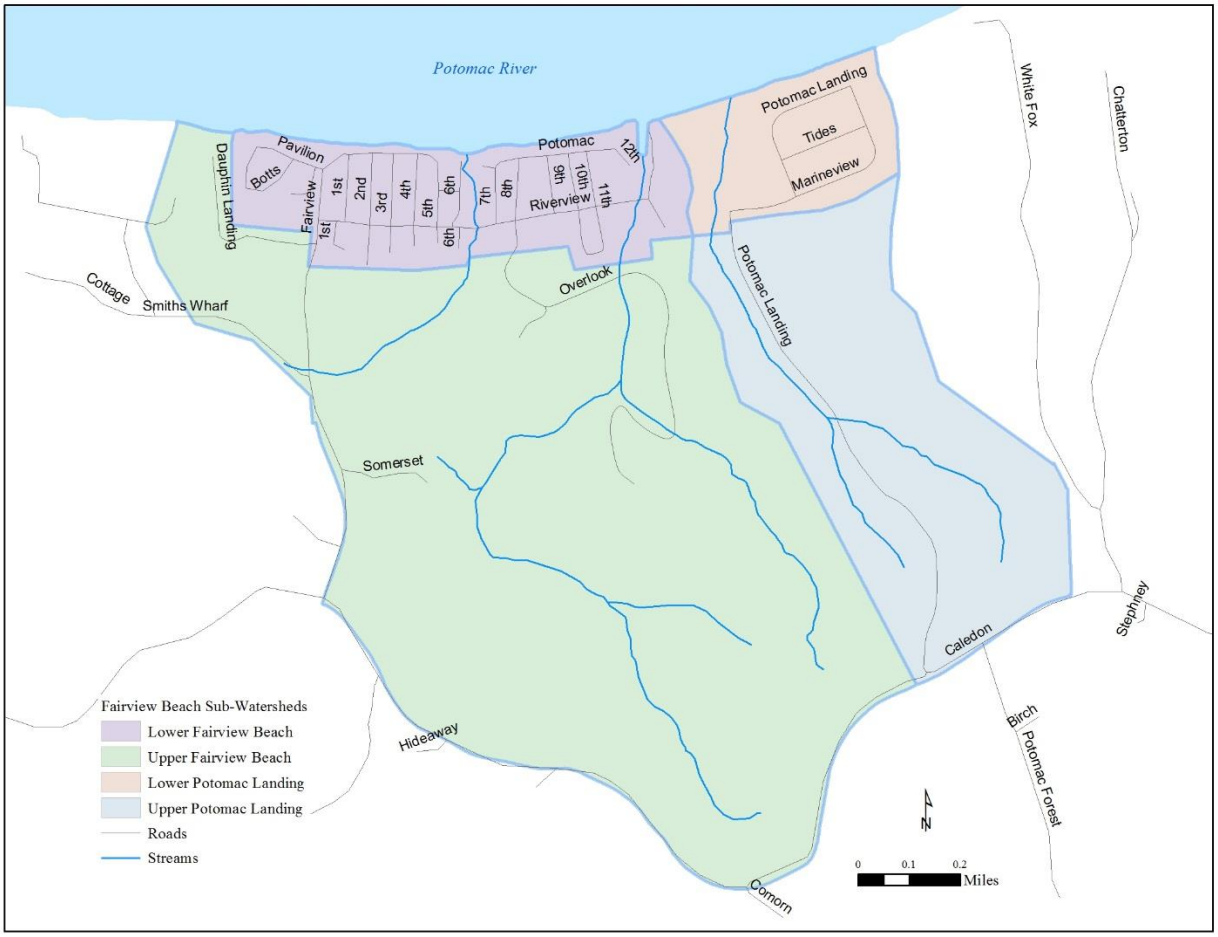
Fairview Beach is served by the King George County Service Authority (KGSA), which provides water and sewer services to the settlement area. The original wastewater treatment plant began operation in 1982. A new plant with a 0.2 mgd treatment capacity began operating in 2009. The settlement area currently includes not only the original subdivisions of Fairview Beach but the recently developed subdivision of Potomac Landing to the east, where the new plant is located. KGSA estimates that no more than two or three homes within the PSA may still be using septic systems (personal communication, C. Thomas and S. Sweney, 2013). There are about 40 homes on large lots in the bluffs outside the PSA; these homes are served by onsite wastewater systems.

2.1.1 Delineation of Sub-watersheds

The Fairview Beach Watershed Plan calls for management measures to be implemented over the entire PSA, including Potomac Landing, and the surrounding drainage area. **Figure 2-2** shows the drainage area contributing directly to the Potomac River in the current Fairview Beach PSA. The drainage area is divided into two separate watersheds, the first draining to the original subdivisions of Fairview Beach, the second draining to the new Potomac Landing development. Each watershed is divided into the portion in the Settlement Area and the upper portion draining from the bluffs overlooking the Potomac, creating a total of four sub-watersheds. The impairment runs along the original Fairview

Beach settlement area. The area draining to the impairment is about one and a quarter mi^2. This includes both the original subdivisions of Fairview Beach within the PSA and bluffs overlooking the Potomac River.

Figure 2-2. Fairview Beach and Potomac Landing sub-watersheds.

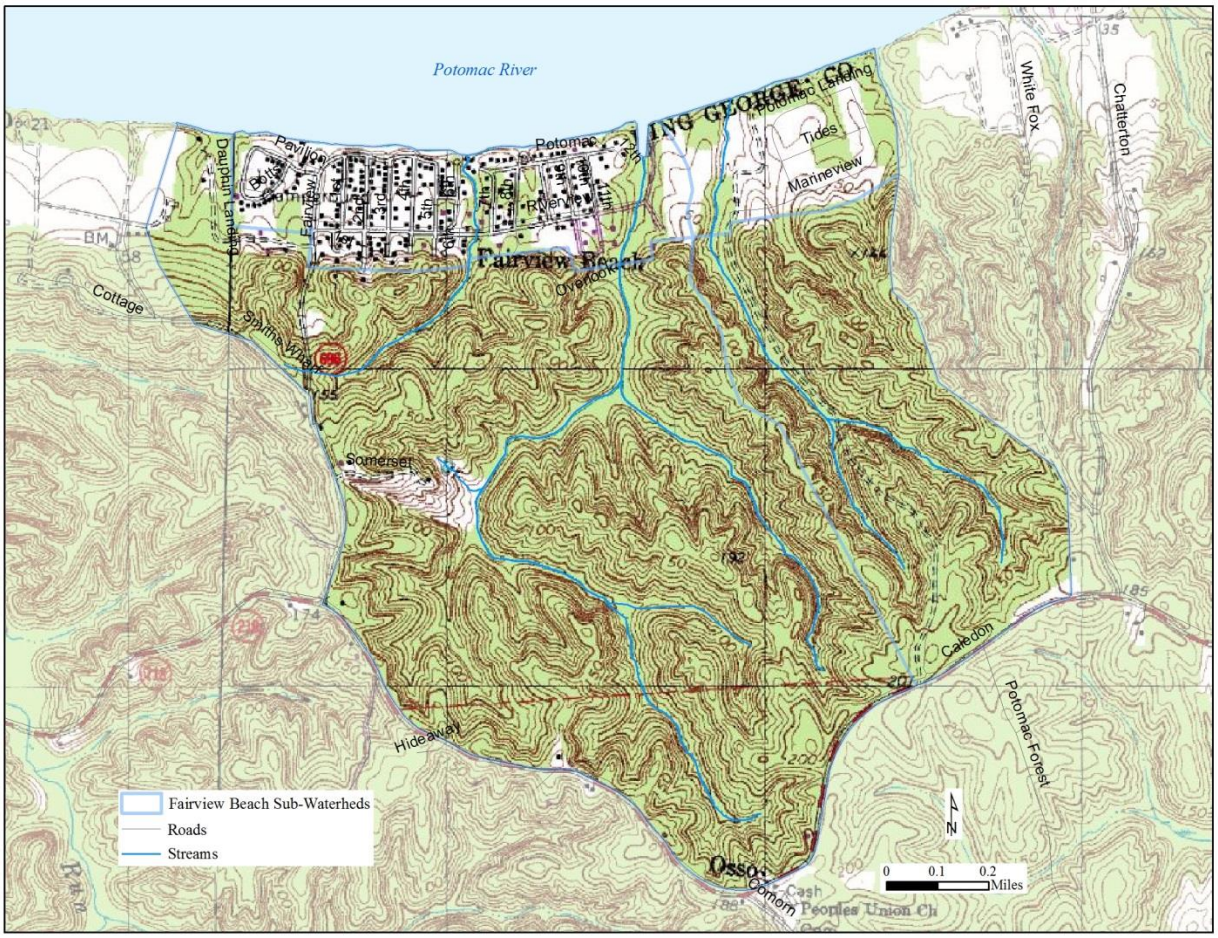


The sub-watersheds were delineated starting with National Hydrography Dataset (NHD) watersheds. Sub-watersheds were corrected manually based on a five foot contour Digital Elevation Model (DEM). The primary settlement boundaries were also delineated manually, based on maps from the King George County Comprehensive Plan (King George County 2013).

2.2 Topography

Fairview Beach is in the Coastal Plain. **Figure 2-3** shows the topography of the Fairview Beach PSA and contributing watersheds. The original subdivisions are set in a marine terrace. Elevation ranges from 0 to 100 ft. The average elevation is 28 ft. In the Potomac Landing subdivision, elevations range from 0 to 70 ft., with an average elevation of 24 ft. Slopes in the PSA range from 0 to 6%. Overlooking the PSA are bluffs rising to an elevation of 215 ft. with 15 to 30% slopes.

Figure 2-3. Fairview Beach topography.



2.3 Soils

Figure 2-4 gives a map of the major soil types in the Fairview Beach sub-watersheds. **Table 2-1** summarizes the acreage of each soil type by sub-watershed. Woodstown fine sandy loam is the dominant soil in the original subdivisions. According to the 2010 King George County soil survey (NRCS 2013), the use of the soils in the original subdivisions for septic fields is severely limited because the water table can be within 1.5 ft. of the surface. In the Potomac Landing subdivision, Sassafras and Caroline soils dominate. The dominant soils on the bluffs are of the Caroline-Sassafras complex and sandy and clayey soils from Caroline and Sassafras materials.

Figure 2-4. Soils in Fairview Beach sub-watersheds.

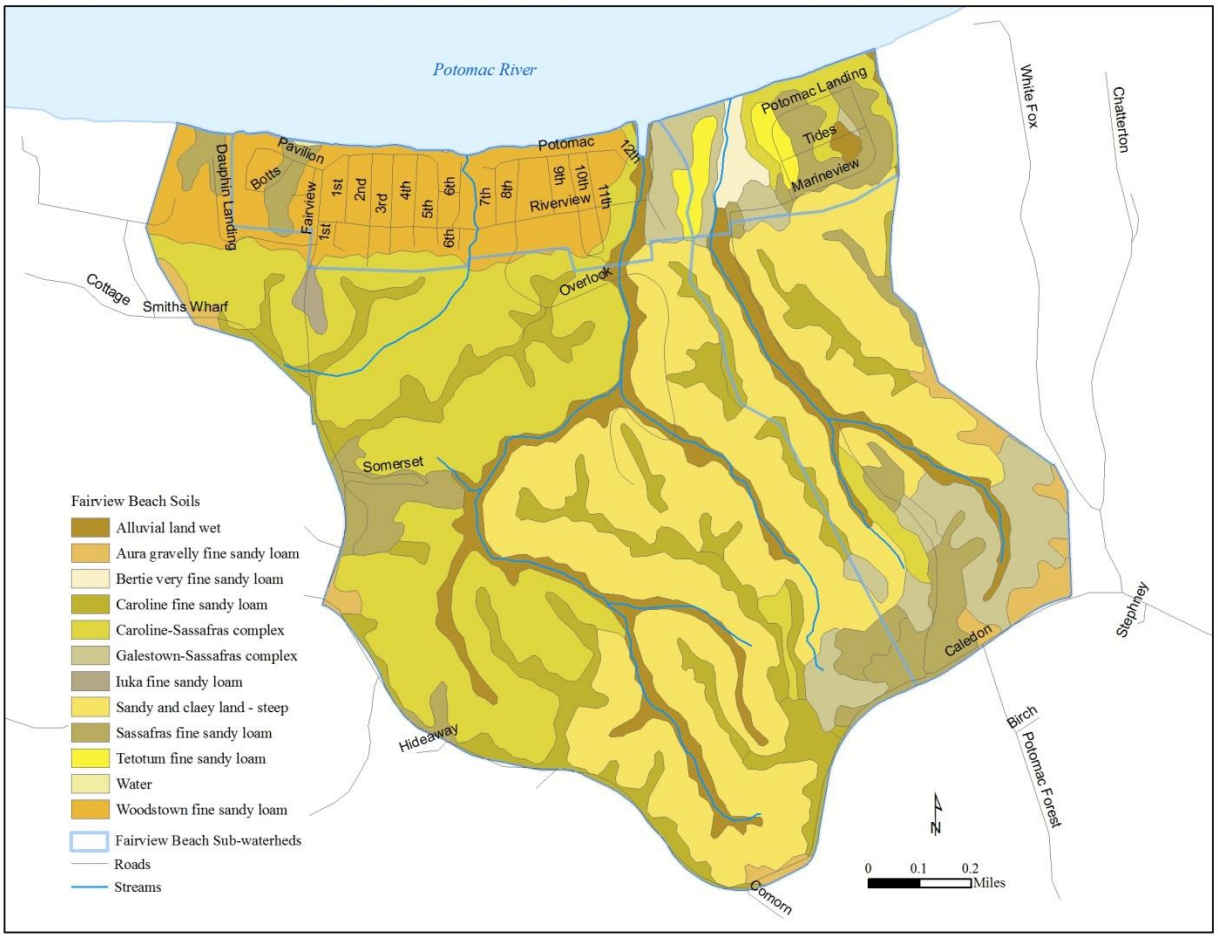


Table 2-1. Soil types and areas by sub-watershed (acres).

Soil type	Lower Fairview Beach	Upper Fairview Beach	Lower Potomac Landing	Upper Potomac Landing	**Total**
Alluvial land, wet	4.8	50.0	3.6	22.3	**80.6**
Aura gravelly fine sandy loam	0.0	7.4	0.0	14.5	**22.0**
Bertie very fine sandy loam	0.0	0.0	7.6	0.0	**7.6**
Caroline fine sandy loam	0.0	105.6	0.0	13.7	**119.3**
Caroline-Sassafras complex	12.2	221.6	14.0	7.0	**254.9**
Galestown-Sassafras complex	8.2	9.6	10.2	41.5	**69.5**
Iuka fine sandy loam	0.0	3.2	0.0	0.0	**3.2**
Sandy and clayey land	0.6	226.5	3.7	100.4	**331.3**
Sassafras fine sandy loam	5.9	36.5	20.0	26.1	**88.6**
Tetotum fine sandy loam	2.1	0.1	9.5	0.0	**11.7**
Woodstown fine sandy loam	93.2	19.9	0.0	0.0	**113.0**

Table 2-2 gives the acres of each hydrologic soil group by sub-watershed. The hydrologic soil groups represent different levels of infiltration capacity of the soils. Hydrologic soil group "A" designates soils that are well to excessively well drained, whereas hydrologic soil group "D" designates

soils that are poorly drained. Consequently, more rainfall becomes part of the surface water runoff in poorly drained soils. Descriptions of the hydrologic soil groups are presented in **Table 2-3**. According to **Table 2-2**, less than 20% of the soils can be classified as well-drained or excessively well-drained; in most of the soils in the Fairview Beach sub-watersheds there is a high water table, fine-textured surface layer, or a sub-surface layer that impedes infiltration and enhances runoff.

Table 2-2. Soil hydrologic group by sub-watershed (acres).

Soil Hydrologic Group	Lower Fairview Beach	Upper Fairview Beach	Lower Potomac Landing	Upper Potomac Landing	**Total**
A	8.2	9.6	10.2	41.5	**69.5**
B	5.9	44.0	27.6	40.6	**118.1**
B/D	0.6	226.5	3.7	100.4	**331.2**
C	107.5	350.3	23.5	20.7	**502.0**
C/D	4.8	50.0	3.6	22.3	**80.7**

Table 2-3. Description of soil hydrologic groups.

Soil Hydrologic Group	Description
A	High infiltration rates. Soils are deep, well-drained to excessively-drained sand and gravels.
B	Moderate infiltration rates. Deep and moderately deep, moderately well and well-drained soils with moderately coarse textures.
C	Moderate to slow infiltration rates. Soils with layers impeding downward movement of water or soils with moderately fine or fine textures.
D	Very slow infiltration rates. Soils are clayey, have a high water table, or shallow to impervious cover.

2.4 Land Use Analysis

Three land uses types were selected to represent the Fairview Beach sub-watersheds: pervious developed land, impervious developed land, and forest. Based on observation, the forest land use only occurs in the Upper Fairview Beach and Upper Potomac Landing sub-watersheds.

The calculation of acreage for each land use in each sub-watershed was based on information derived from Geographic Information Systems (GIS) analysis and some auxiliary assumptions. GIS analysis was used to determine 1) the number of households in the sub-watershed, 2) the length of streets and roads, and 3) the total sub-watershed area. **Table 2-4** shows the GIS layers that formed the basis for each analysis.

Table 2-4. Sources of GIS information.

Feature	Layer	Source
Delineation	National Hydrography Dataset	http://nhd.usgs.gov/data.html
Housing	Census Blocks	http://www.census.gov/geo/
Roadways	Streetmap USA	http://www.esri.com/

Roads and Streets: Streets and roads were taken from Environmental Systems Research Institute's (ESRI) Streetmap USA. The road layer in the vicinity of Potomac landing was re-delineated using information from Google Earth. Roadways are shown in **Figure 2-2**.

Households: The U.S. Census provides household data by census block. The 2010 census block layer was intersected with the sub-watershed delineation. **Figure 2-5** shows the census blocks in the vicinity of Fairview Beach. The households in census blocks spanning more than one sub-watershed were assigned to sub-watersheds based on satellite imagery from Google Earth.

Figure 2-5. Census blocks in the vicinity of Fairview Beach.

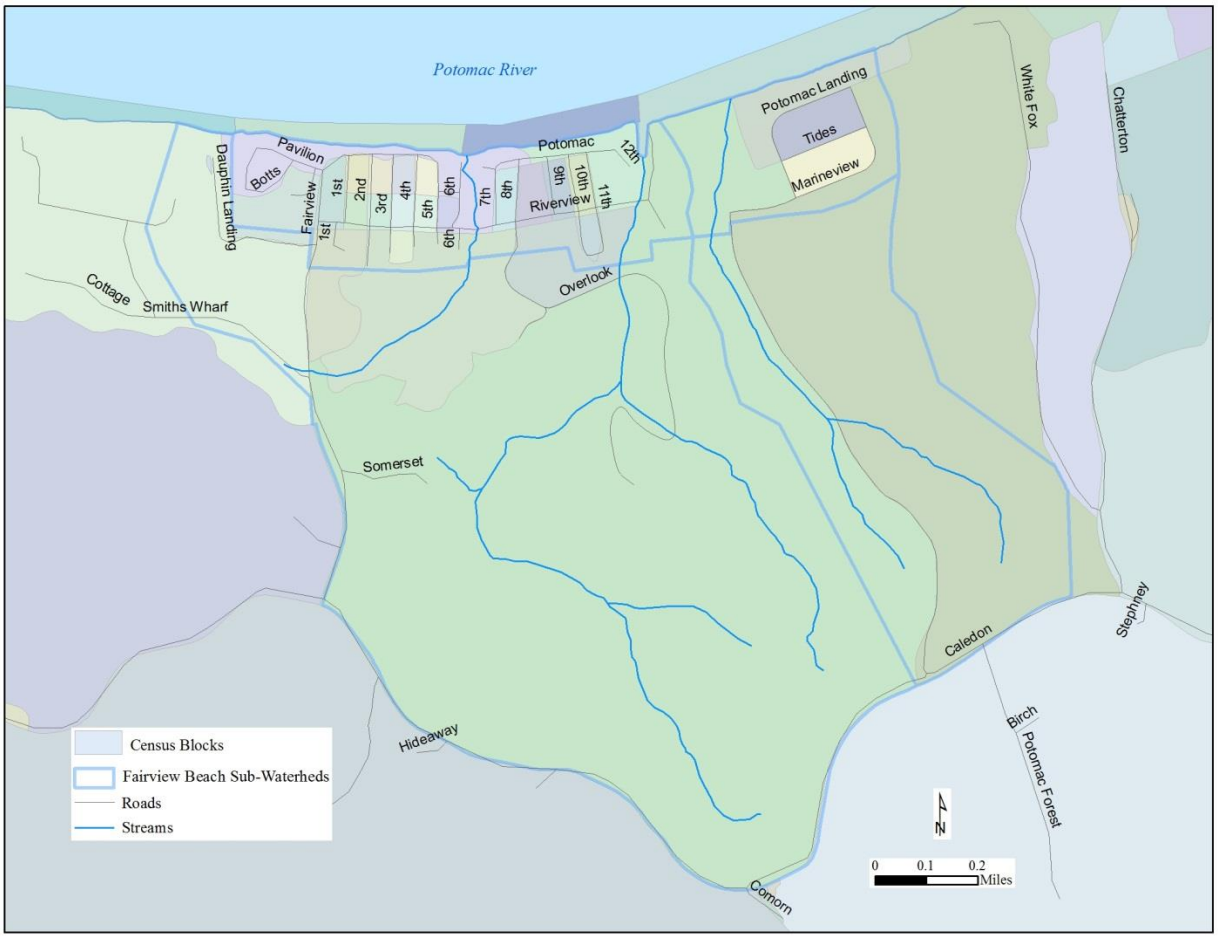


Table 2-5 gives the area, length of roadways, and number of households for each sub-watershed.

Table 2-5. Sub-watershed area, households, and roadway lengths.

Sub-watershed	Area (acres)	Households	Two-way Roadway (ft.)	One-way Roadway (ft.)
Lower Fairview Beach	128	302	10,527	10,702
Upper Fairview Beach	680	36	22,745	0
Total Fairview Beach	**808**	**338**	**33,272**	**10,702**
Lower Potomac Landing	69	52	5,161	0
Upper Potomac Landing	226	6	7,068	0
Total Potomac Landing	**294**	**58**	**12,228**	**0**

Auxiliary assumptions about impervious area were taken from Claggett et al. (2012), which was used in determining the impervious areas in rural areas for the Chesapeake Bay Program's Phase 5 Watershed Model. These assumptions are:

1. In rural areas there is approximately 0.15 acres of impervious area per household;
2. The width of one-lane roads and streets is 17 ft.; and
3. The width of two-lane roads is 22 ft.

The first assumption does not hold for the densely developed original settlement of Fairview Beach. It was assumed that land use in the original settlement consists entirely of roads and developed lots, although a there is a small, undeveloped portion of the original settlement area held in common. The King George County Comprehensive Plan (King George County 2013) reports that lots in the original settlement area were 50-70% impervious. For this analysis, it was assumed that lots in this area were 60% impervious.

Acreage for each land use was determined by slightly different methods in the four sub-watersheds shown in **Figure 2-2**. The methods of calculation are discussed below:

Fairview Beach Original Settlement Area

1. Streets running north-south were treated as one-lane roads; all other streets and roads are two-way. The impervious areas associated with streets and roads are the length multiplied by width (17 ft. for one-lane streets and 22 ft. for the two-lane streets and roads);
2. Area of developed lots = total watershed area – impervious surfaces associated with streets and roads (there is no forest in this sub-watershed);
3. Impervious area of lots = 0.6 * area of developed lots;
4. Total impervious developed area = impervious area of developed lots + impervious surfaces of streets and roads;
5. Pervious developed area = 0.4 * area of developed lots.

Potomac Landing

1. Impervious surfaces associated with streets and roads = length of roadways * 22 ft.;
2. Impervious area of lots = 0.15 * number of households;
3. Impervious developed area = impervious area of roadways + impervious area of lots;
4. Pervious developed area = total sub-watershed area – impervious developed area (no forest in this sub-watershed).

Upper Sub-watersheds for Fairview Beach and Potomac Landing

1. According to the King George County Comprehensive Plan (King George County 2013) the minimum lot size for these areas is two acres; it was assumed each house has two acres of developed land;
2. Area of developed lots = number of households * 2 acres;
3. Impervious area of developed lots = 0.15 acres * number of households;
4. Impervious area of roadways = 22 ft. * length of roadways;
5. Impervious developed area = impervious area of developed lots + impervious area of roadways;
6. Pervious developed area = area of developed lots – impervious area of lot (or 1.85 acres*number of households);
7. Forest = total sub-watershed area – impervious developed area – pervious developed area.

Table 2-6 gives the land use acreages for each sub-watershed.

Table 2-6. Sub-watershed land use acreages.

Sub-watershed	Impervious Developed	Pervious Developed	Forest	Total
Lower Fairview Beach	80	47	0	128
Upper Fairview Beach	17	67	597	680
Total Fairview Beach	**97**	**114**	**597**	**808**
Lower Potomac Landing	10	58	0	69
Upper Potomac Landing	4	11	210	226
Total Potomac Landing	**15**	**69**	**210**	**294**

2.5 Population

Table 2-7 shows the population by sub-watershed according to the 2010 U.S. Census. The analysis was carried out at the census block level, as shown in **Figure 2-5**. If a census block was only partially in a sub-watershed, the number of houses, as identified visually on Google Maps, was multiplied by the number of persons per household in that census block as a whole to obtain the population of the portion of the census block in the sub-watershed. According to King George County Comprehensive Plan (King George County 2013), the resident population in the Fairview Beach PSA in 2011 was 930, which is considerably higher than the census block estimate. The difference is probably due to the fact that many of the homes in Fairview Beach are a second residence for their owners, and the population of the PSA can be expected to fluctuate seasonally.

Table 2-7. Population in Fairview Beach sub-watersheds (2010 U.S. Census).

Sub-watershed	Population	Houses	Population per House
Lower Fairview Beach	376	302	1.2
Upper Fairview Beach	68	36	1.9
Total Fairview Beach	**444**	**338**	**1.3**
Lower Potomac Landing	113	52	2.2
Upper Potomac Landing	13	6	2.2
Total Potomac Landing	**126**	**58**	**2.2**

2.6 Community Life

Fairview Beach is a small community perched along a bluff of the Potomac River, with beautiful water views from many home locations as the neighborhood slopes towards the river. The residents enjoy access to a small beach area and marina access for boating enjoyment. In addition to the beach, there are common areas where gatherings are often held, such as spaghetti suppers and barbeques. The festive Aquapalooza event features a floating stage for musical events and other festivities for residents and boaters in the area. There is a community newsletter, e-mail notifications, and website that are used to inform residents of matters such as the erosion control project, the beach clean-up day, boater safety, pet waste collection, and special events. Golf carts and walkers are often found on the quaint, narrow streets. The residents pull together to raise funds for concerns such as the beach erosion project, taking a proactive approach to protecting their portion of shoreline and property from the effects of major storm events. Overall, Fairview Beach provides a very quiet setting for residents to enjoy their natural

surroundings while very easily getting to know one another due to the close proximity of their homes and pedestrian friendly community.

3 Stakeholder Involvement

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private citizens, and special interest groups. Achieving the goals of the Fairview Beach Watershed Plan (i.e. improving water quality and removing these waters from the impaired waters list) is dependent on stakeholder participation. Both the local stakeholders who are charged with the implementation of control measures and the government stakeholders who are responsible for overseeing human health and environmental programs must first acknowledge there is a water quality problem, and then make the needed changes in operations, programs, and legislation to address the pollutants. Stakeholders will help guide the implementation of practices, and evaluate approaches during Phase 2 implementation based on the success of approaches during Phase 1 (see **Chapter 6** for a description of the phased implementation schedule). A description of key organizations is provided below followed by a description of the public participation process utilized in the development of this plan.

The **EPA** has the responsibility for overseeing the various programs necessary for the success of the CWA. However, administration and enforcement of such programs falls largely to the states. In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are five state agencies responsible for regulating and providing educational outreach for activities that impact water quality with regard to this watershed plan. These agencies include: DEQ, Virginia Department of Conservation and Recreation (DCR), VDH, Virginia Department of Agriculture and Consumer Services (VDACS), and Virginia Cooperative Extension (VCE).

DEQ has responsibility for monitoring the waters to determine compliance with state standards, and for requiring permitted point source dischargers to maintain pollutant loads and concentrations within permit limits. They have the regulatory authority to levy fines and take legal action against those in violation of permits. Some facilities fall under the Virginia Pollution Discharge Elimination System (VPDES) program and others fall under the Virginia Pollution Abatement (VPA) General Permit regulation for Poultry Waste Management and the Biosolids Management Program. Violations of permit requirements are handled via corrective actions with the facility through the compliance and enforcement program at DEQ. DEQ is also now the lead agency on nonpoint source discharges and pollution control, including stormwater permitting and erosion and sediment control. Additionally, DEQ is responsible for presenting this watershed plan to the State Water Control Board for approval as the plan for implementing pollutant allocations and reductions to meet water quality standards. DEQ also works with localities to assist in the development of No-Discharge Zones for local waters. Their Division of Chesapeake Bay Local Assistance enforces compliance with the Chesapeake Bay Preservation Act (CBPA), including septic pump-out requirements and the protection of Resource Protection Areas and Resource Management Areas. DEQ also administers the Section 319 and Virginia Water Quality Improvement Fund (WQIF) grant programs.

DCR programs deal with agricultural nonpoint source pollution through education and voluntary incentive programs. These cost-share programs were originally developed to meet the needs of voluntary partial participation and not the TMDL- required 100% participation of stakeholders. To meet the needs

of the TMDL program and achieve the goals set forth in the CWA, the incentives under this program have been adjusted to account for 100% participation. Although there are some livestock within the project area, waste handling was determined to be appropriately implemented at this time and there are no real opportunities for agricultural cost share projects.

VDH is responsible for maintaining safe drinking water measured by standards set by EPA. Their duties also include On-Site Sewage Disposal regulation. Like VDACS, VDH's program is complaint-driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation from a failed septic system that may take many weeks or longer to achieve compliance. VDH has the responsibility of enforcing actions to correct or eliminate failed septic systems and straight pipes (Sewage Handling and Disposal Regulations, 12 VAC 5-610-10 et seq.). Their Division of Shellfish and Sanitation (DSS) is responsible for protecting the health of shellfish consumers by ensuring that growing waters are properly classified for harvesting. DSS monitors water quality in shellfish growing areas and provides shellfish closings and sanitary surveys to identify deficiencies along the shoreline. VDH also administers the Clean Marina Program to address the proper operation of pump-out facilities and boater education. Their Beach Monitoring program has provided much of the data used to determine the violations of the recreational use water quality standard for bacteria.

VCE is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University), and a part of the national Cooperative State Research, Education and Extension Service, an agency of the U.S. Department of Agriculture. VCE is a product of cooperation among local, state, and federal governments in partnership with local citizens. VCE offers educational outreach and technical resources on topics such as crops, grains, livestock, dairy, horse pasture management, natural resources, and environmental management. VCE has several publications related to TMDLs and is promoting water quality education and outreach methods to citizens, businesses, and developers regarding necessary pet waste reductions. For more information on publications and county extension offices, visit www.ext.vt.edu, accessed 7/5/2014.

VDGIF (Virginia Department of Game and Inland Fisheries) manages Virginia's wildlife and inland fish to maintain optimum populations of all species to serve the needs of the Commonwealth; provides opportunity for all to enjoy wildlife, inland fish, boating and related outdoor recreation; and promotes safety for persons and property in connection with boating, hunting, and fishing. The VDGIF has responsibility for administering certain U.S. Fish and Wildlife Service funding programs. Personnel participate, review, and comment on projects to insure consideration for fish and wildlife populations and associated habitats. They may assist with wildlife education and management programs.

The **Tri-County/City Soil and Water Conservation District** (TCCSWCD) works with many agricultural producers in the region to improve agricultural practices and minimize impacts to the area waterways. TCCSWCD serves King George, Spotsylvania, and Stafford counties and the city of Fredericksburg. In this heavily cropped and forested region, they play an integral role in developing and implementing natural resource protection strategies. In addition to the farming community, TCCSWCD works with citizens on erosion and sediment related compliance concerns and encourage innovative techniques for dealing with stormwater. Their rain barrel workshops are very popular with homeowners, and their diverse partnerships add to their ability to convey a variety of water quality related education programs across the region. They have already provided the Fairview Beach community with ten pet waste bag stations and educational signs.

State government has the authority to establish state laws that control delivery of pollutants to local waters. Local governments, in conjunction with the state, can develop ordinances involving pollution prevention measures. The county of King George, where Fairview Beach is located, has established local Bay Act programs under the authority of the CBPA and the Chesapeake Bay Preservation Area Designation and Management Regulations. These local programs protect water quality by managing land use, development, and re-development activities through provisions within each county's local code. The requirements of the local programs apply within the areas designated as Chesapeake Bay Preservation Areas by each locality. **King George County** has designated these areas jurisdiction-wide. The CBPA requirements include the designation of vegetated 100 foot riparian buffers and reserve drainfields on plats and plans of development and documentation of inspection/pump-out and maintenance of on-site septic systems every five years. The county has established a program to notify subject property owners and track the status of on-site septic systems in order to document enforcement. Also related to the CBPA, the county supports the re-establishment of streamside buffers in their comprehensive plan. The plan also lists the Fairview Beach Satellite area as a top candidate for re-development, supporting alternative methods of stormwater treatment due to the small lot development and high ratio of impervious surfaces. King George County is committed to pet owner education, possibly through dog licensing or other regular mailings to land owners, but would need assistance through other area groups like the TCCWCD for the content of materials. They also considered including water quality educational information in tax bills and pump-out reminder notices for greater citizen awareness of these issues. The county, in particular KGSA, will be a key partner with other stakeholders in seeking grant funds to repair/replace failing on-site sewage disposal systems, connect failed septic systems to existing sewer infrastructure, and to assist with the various educational programs proposed in the watershed plan. As of July 1, 2014, King George County began administering their own Virginia Stormwater Management Program for the permitting of new construction projects, requiring the management of water quality and quantity of runoff from land disturbing activities.

The **George Washington Regional Commission** assists with regional planning needs and provides a variety of technical and program services to member local governments, including grant application assistance, management services for program implementation, land use planning services, and mapping. Transportation planning including highway development, ridesharing, airport planning, and specialized transit is another role filled by Planning District Commissions in the state. Right now, they are also helping the county gather information on natural gas fracking and whether any communities are adopting ordinances to limit fracking activities.

The **Virginia Institute of Marine Science** (VIMS) provides technical assistance and research on issues related to the restoration of Virginia's tidal watersheds. Their Center for Coastal Resource Management periodically conducts shoreline inventories that indicate the need for buffers and various shoreline stabilization techniques. Their Shoreline Situation Report for King George County, completed in October 2008, documents bank conditions and shoreline features in the Fairview Beach area.

The Fairview Beach Residents Association (FBRA**)** consists of a group of citizens who work together to inform residents of necessary rules and requirements in the neighborhood and work together to solve problems, such as the shoreline erosion. Many residents love to swim and boat and they have also made correcting deficiencies that contribute to the bacteria problems and beach closures a priority in recent years. Some of the citizens have taken a very active role in the citizen water quality monitoring to aid in the determination of bacteria pollution hotspots. There has been excellent representation from these

citizens during the watershed plan development process. They will assist with educational outreach related to this project and citizen water quality monitoring.

3.1 Outreach/public participation

Collecting input from the public on restoration and outreach strategies to include in the watershed plan was a critical step in this planning process. Since the plan will be implemented primarily by watershed stakeholders on a voluntary basis with some financial incentives, local input and support are the primary factors that will determine the success of this plan. The actions and commitments compiled in this document were developed by citizens in the watershed, King George County governments, TCCWCD, DCR, DEQ, VDH, and business owners in Fairview Beach. All citizens and interested parties in the watershed are encouraged to put the watershed plan into action and contribute whatever possible to the restoration of water quality.

Public meetings were held to inform the public regarding the end goals and status of the watershed plan development, as well as to provide a means for soliciting participation in the smaller, more targeted meetings (i.e. working groups). Working groups were assembled from communities of people with common concerns regarding the TMDL process and were the primary arena for seeking public input. The working groups formed for this watershed plan were the community (CWG) and government (GWC). Meeting minutes and work products from these meetings are provided in **Appendix A**.

Representatives of DEQ and ICPRB attended each working group meeting in order to facilitate the process and integrate information collected from the various attendees. The first public meeting was held at the L.E. Smoot Memorial Library on February 20, 2014, from 6:00-8:00 pm. The meeting was publicized in The Virginia Register, Free Lance Star, and the FBRA website. A substantial contact list developed prior to the meeting was also used to notify residents by e-mail. The meeting was attended by 24 people, including 11 citizens, 2 consultants, and 11 government agency representatives. Information discussed at the meeting included a general description of the study summary for the Fairview Beach bacteria impairment, a more detailed description of the watershed plan development process, and a solicitation for participation in working groups. At the meeting, it was determined that two working groups would best represent the interests in the watersheds: Community, due to the very small footprint of the project with primarily residential interests, and Government. The CWG met during the latter portion of this meeting.

The final public meeting was held on July 23, 2014 at the L.E. Smoot Memorial Library from 6:00-8:00 pm, and was attended by 20 people, including 10 citizens and 10 government/contract staff. The primary purpose of this meeting was to present the draft watershed plan. A presentation was given describing the watershed plan using major components as an outline: review of the bacteria impairment study, public participation, assessment of needs, cost/benefit analysis, and implementation goals and phasing of projects. Maps with land use and VDH and Virginia Tech (VT) water quality monitoring stations were displayed. Tables of implementation actions for the watershed were also displayed. Several copies of the draft watershed plan were made available but attendees were advised to check the DEQ website the following day in order to review the draft document and presentation.

3.2 Working Groups

Working groups were formed to deal with a number of specific implementation issues, including residential concerns (septic deficiencies, sewer connection problems, stormwater runoff, and pet waste)

and government-related topics. Their representation included members from the community, government employees, and members of other organizations with specific technical knowledge.

The CWG met twice during the development of the watershed plan. The first CWG meeting was held on February 2, 2014 and was attended by 22 people. At the first meeting, a series of questions was used to help guide both discussions. SC members (4) were also selected to represent the CWG. At the second meeting, held May 15, 2014, the group of 15 people reviewed additional stormwater monitoring data, the updated source assessment for the watershed, discussed BMP/corrective action scenarios and potential locations for them within the community, discussed cost estimates for each BMP, and developed a potential timeline for implementation. There was much discussion about methods needed to reduce human and pet sources of bacteria entering the beach area and the stormwater conveyances that may be contributing to the problem. The group recommended methods to identify failing septic systems and faulty sewer connections (as well as promoting replacement of these), and provided input regarding BMPs that would be required. Though there are only one or two small "farmettes", they were discussed and determined to be properly managed at this time. The management of marina operations and their ability to address boating traffic pump-out needs was also discussed, as were educational programs to address proper waste disposal.

The GWG met on May 6, 2014, and was attended by ten people. The GWG addressed the resources and commitments of local, state, and federal agencies that would contribute to the improved water quality of Fairview Beach. Also included were existing regulatory control efforts, which may improve the quality of the beach area. Existing programs and funding opportunities were discussed, and a responsibility portion of the load reduction spreadsheet was reviewed and discussed as a starting point to beginning program implementation. At this meeting, the potential action scenarios were reviewed, potential BMP locations were placed on a large map (**Appendix A**), and a representative was selected to assist with the report to the SC.

The SC met on July 10, 2014, and was attended by 12 people for the review of the draft watershed plan and CWG and GWG reports. The SC was made up of the working group representatives, agency representatives, citizens, and contractors. The SC members also provided comments on the PowerPoint presentation for the July 23rd public meeting. The SC made editorial and substantive suggestions for changes of the draft watershed plan document via e-mails and ensured that all recommendations of the working groups were incorporated into the plan. Overall, an impressive number of hours were spent by many community members and staff in the development of this plan. There was a consensus on the need for continued educational efforts for homeowners, pet owners, marina operators, and boaters. There was also agreement on the need for strong partnerships between agencies and citizens who were trying for the same end goal: improve the Fairview Beach conditions for the benefit of existing and potential residents, and for those who simply visit this small Potomac River community.

Successful implementation depends on stakeholders taking responsibility for their role in the process. While the primary role falls on the land owner, the local, state and federal agencies also have a stake in seeing that Virginia's waters are clean and provide a healthy environment for its citizens. While it is unreasonable to expect that the natural environment (e.g. creeks and rivers) can be made 100% free of risk to human health, it is possible and desirable to minimize pollution related to humans. Virginia's approach to correcting nonpoint source pollution problems has been, and continues to be, primarily encouragement of participation through education and financial incentives. However, this watershed plan identified several regulatory controls (i.e. Sewage Handling and Disposal Regulations, CBPA, etc.) that could foster implementation actions. While this watershed plan has been prepared for bacteria

impairments in the Fairview Beach watershed, many of the BMPs will also result in reductions in nutrients and sediment reaching the Chesapeake Bay and therefore contribute also to the improvements called for in the Chesapeake Bay Watershed Implementation Plan.

4 Defining the Bacteria Problem

Fairview Beach is not meeting Virginia's recreational bacteria standard for transitional waterbodies between freshwater and saltwater and is therefore not supporting its designated use for primary contact recreation. This chapter explains the applicable bacteria standard and reviews the monitoring data that demonstrate that Fairview Beach is not attaining the standards. It also provides an analysis of all relevant monitoring data collected at Fairview Beach in the past decade. Based on the analysis of that monitoring data, a conceptual model is developed which identifies the sources of bacteria and the transport paths by which they impact Fairview Beach. The conceptual model explicitly includes a simple model of the Fairview Beach sub-watersheds that quantifies the bacteria in surface flow and baseflow from these sources. Finally, target bacteria load reductions for sources and transport paths for Fairview Beach are determined, based on the quantification of bacteria loads in the conceptual model.

4.1 Applicable Water Quality Standard

Water quality standards consist of designated uses for a waterbody and water quality criteria necessary to support those designated uses. According to Virginia water quality standards (9 VAC 25-260-5), the term "water quality standards means provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal CWA (33 USC §1251 et seq.)." According to Virginia water quality standards (9 VAC 25-260-10):

> *"all state waters are designated for the following uses: recreational uses (e.g. swimming and boating); the propagation and growth of a balanced indigenous population of aquatic life, including game fish, which might be reasonably expected to inhabit them; wildlife; and the production of edible and marketable natural resources (e.g. fish and shellfish)."*

Effective February 1, 2010, DEQ specified a new bacteria standard in 9 VAC 25-260-170 A. Fairview Beach is in the transitional zone of the Potomac River, between tidal freshwater and saltwater (9 VAC 25-260-140 C). For a non-shellfish, transitional or saltwater waterbody to be in compliance with Virginia bacteria standards for primary contact recreation, the current criteria are as follows:

> *"Enterococci bacteria shall not exceed a monthly geometric mean of 35 CFU/100 ml in transition and saltwater...Geometric means shall be calculated using all data collected during any calendar month with a minimum of four weekly samples… If there are insufficient data to calculate monthly geometric means in transition and saltwater, no more than 10% of the total samples in the assessment period shall exceed 104 CFU/100 ml."*

Enterococci are bacteria found in the intestines of warm-blooded animals. They are not harmful in themselves but are monitored to indicate the presence of fecal contamination and therefore the possible

presence of pathogens which can cause waterborne illnesses. These pathogens include types of bacteria (*Shingella, Salmonella*), viruses (rotaviruses, Norwalk virus), protozoan parasites (Cryptosporidium, *Giardia lamblia*), and other micro-organisms. Typical symptoms of waterborne illnesses include diarrhea, cramps, nausea, or headaches, but the consequence of infection can be more severe. Infants, young children, the elderly, and people with compromised immune systems are particularly at risk (EPA 2014; VDH 2014).

4.1.1 Fairview Beach Bacteria Impairment

Since 2004, the beach water has been monitored for fecal indicator bacteria on a weekly basis by the VDH Rappahannock Health District. Water samples are analyzed for *Enterococci* bacteria to determine if beach water meets Virginia's water quality standards for primary contact recreation (swimming). The monitoring shows that the beach frequently does not meet water quality standards. Based on its monitoring, VDH has issued swimming advisories for Fairview Beach an average of four times per year, and the beach has been under a swimming advisory an average of 18 days a year. **Table 4-1** shows the number of advisories and the number of days per year the beach has been under advisory from 2004 through 2013.

Table 4-1. Fairview Beach closures, 2004-2012.

Year	Number of Advisories	Days Under Advisory
2004	4	13
2005	2	8
2006	3	33
2007	6	32
2008	5	24
2009	5	16
2010	4	18
2011	4	22
2012	5	10
2013	2	5
Average	4.0	18.1

Based on VDH monitoring data, Fairview Beach is not meeting the water quality standard for bacteria for its Primary Contact (Swimming) Use, and in 2006 DEQ placed Fairview Beach on Virginia's List of Impaired Waters. The impairment runs between the shoreline of the original settlement area and the Virginia state line at the low water mark on the Potomac River. **Table 4-2** gives the specification of the impairment.

Table 4-2. Fairview Beach bacteria impairment.

Name	Cause Group Code	Description	Size	Initial Listing
Fairview Beach (Potomac River)	A29E-02-BAC	Includes all of Fairview Beach on the Potomac River	0.012 mi^2	2006

4.2 Analysis of Monitoring Data

In addition to the monitoring performed by VDH, bacteria monitoring in and around Fairview Beach has also been performed in cooperation with VDH by VT Department of Crop and Soil

Environment under the direction of Professor Charles Hagedorn. VT actively monitored Fairview Beach between 2004 and 2009. The goal of this sampling was to determine the sources of bacteria impacting Fairview Beach. VT's monitoring also included microbial source tracking (MST) and sampling for Optical Brighteners (OBs). More recently, on November 18, 2013, VDH and VT also monitored bacteria in the water column and sediment at multiple locations following a storm event to help determine the impact of local stormwater on bacteria levels at the beach.

Since 2011, FBRA has worked with the DEQ to perform bacteria monitoring using Coliscan kits provided by DEQ. Coliscan kits provide an inexpensive way of testing for *E. coli* bacteria. FBRA monitoring has primarily focused on three issues: 1) the level of bacteria in local runoff, 2) elevation of bacteria concentrations under agitated conditions, and 3) potential sources of bacteria in the vicinity of the Pavilion Street drainpipe.

A more detailed description of the VDH, VT, and FRBA monitoring programs and their results can be found in **Appendix B**. The following conclusions can be drawn from the bacteria monitoring performed at Fairview Beach:

1. Bacteria concentrations are elevated when river conditions are turbulent, muddy, choppy, or otherwise rough;
2. Bacteria concentrations under turbid or rough conditions tend to decrease moving away from the shoreline, indicating the direct source of bacteria under rough conditions is not the Potomac River;
3. Elevated bacteria concentrations under turbid or rough conditions may not be a problem confined to Fairview Beach;
4. Bacteria concentrations in the Potomac River outside the vicinity of Fairview Beach are generally lower than the concentrations observed at Fairview Beach;
5. Elevated concentrations of bacteria are observed in local stormwater draining Fairview Beach;
6. Although several human sources of bacteria have been identified and rectified, local human sources continue to contribute to the bacteria observed at Fairview Beach; and
7. Eliminating bacteria just from human sources and pets may not be sufficient to fully resolve the bacteria impairment at Fairview Beach.

4.3 Source and Transport Mechanisms for Bacteria

This section reviews the available information on potential sources and transport paths for bacteria at Fairview Beach based on monitoring data, scientific literature, and the observations of sampling personnel and local residents. The goal of this section is to weigh the evidence for the significance of the contribution of sources and transport paths to the bacteria problems at Fairview Beach, and on that basis to build a conceptual model of the fate and transport of bacteria in the vicinity of the beach, which can serve as a foundation for quantifying the benefits of implementation measures.

4.3.1 Human Sources

MST analysis and OB monitoring have indicated that human sources are contributing to the bacteria impairment at Fairview Beach. Although several leaking sewer pipes have been fixed and failing septic drainfields have been circumvented in the vicinity of the Pavilion Avenue drainpipe, not all human sources of bacteria have been addressed. As discussed in **Section 2.3** of **Appendix B**, both MST and OB monitoring show a strong human signal from the intermittent creek draining to the upper end of the drainpipe near Pavilion Drive. The human sources contributing bacteria to the creek have not been identified. MST and OB monitoring also indicated that human sources contributed to the bacteria found

in the sinkhole on 8th Street. Although levels of bacteria and isolates attributed to human sources fell after the sinkhole was filled in, the human source contributing to the sinkhole was also never identified. As described in **Section 4** of **Appendix B**, genetic fingerprinting of bacteria from sediment samples collected from an intermittent stream near 6th Street in November 2013 indicated the presence of bacteria from human sources.

Potential human sources of bacteria include 1) failing septic systems, 2) septic systems with drainfields located too close to waterbodies, 3) faulty connections between residences and sewer lines, and 4) leaks and/or overflows from sewer lines. Examples of some of these sources have been found in the trailer park, and may be present in other parts of Fairview Beach that have not been subject to the same scrutiny. Although Fairview Beach is served by public sewer, there still may be homes on septic systems outside of the trailer park. The soils in Fairview Beach are inappropriate for septic systems, because the water table is close to the surface. Failing septic systems were the primary cause of the construction of the wastewater treatment plant at Fairview Beach in the 1980's. In a study for King George County at that time, Dewberry, Nealon, and Davis (1974) report that in Fairview Beach "during wet periods sewage is leaching through the surface of the ground" (p. 5). Systems that do not exhibit ponded effluent may also be providing insufficient treatment if the bacteria are transported to the water table, and groundwater discharges to surface water nearby. The drainfields between Pavilion Drive and the Potomac River are likely to be too close to the river to provide adequate treatment. If the trailer homes along Botts Lane are served by septic systems, they may also be the source of bacteria observed in the creek above the Pavilion Avenue drainpipe. Preferential groundwater flow paths, caused by installing pipe, may exacerbate the problem. If, for example, the Pavilion Avenue drainpipe was laid in a gravel bed, the bed may be serving as a conduit for groundwater flow, contributing to the high bacteria concentrations observed near the drainpipe outfall.

Home owners themselves are responsible for the connections between their homes and the public sewer lines. Whether these connections have been made correctly, and are functioning correctly without leaking or otherwise discharging effluent, is not known (comment by unidentified resident, Fairview Beach Monitoring Meeting, 9/20/2012).

Residents of Fairview Beach have raised concerns about the large number of boaters attracted to the beach and its restaurants. As discussed in **Section 2.6** of **Appendix B**, there are hundreds of boats in the vicinity of Fairview Beach during some special events. As also reported in that section, however, VT monitored the waters off Fairview Beach during two of those large events and the observed bacteria concentrations were low.

4.3.2 Dogs

VT reports regularly determined through MST analysis that pets, specifically dogs, were contributing to the bacteria found at Fairview Beach. VT staff (2007) reported that dogs are not restricted from the beach, and dog waste was observed near the beach in every year they sampled there.

4.3.3 Birds and Wildlife

Birds account for the largest percent of isolates identified by MST analysis at Fairview Beach, yet it is not apparent where the population of birds contributing to the bacteria problems at Fairview Beach resides. Fairview Beach residents report seeing as many as 250-300 seagulls on the piers along Fairview Beach from September to March, but only one or two birds are present during the swimming season (personal communication, J. Harrover, 6/18/2014). VT staff (2005) reported that "trash was not a

problem" at Fairview Beach, implying that there is not enough trash to attract a large number of gulls in the vicinity of the beach. Observed bacteria concentrations are low in the vicinity of Caledon State Park, about one and a half miles downstream of Fairview Beach.

Cover et al. (2011) determined that there were a "significant number" of geese on a beach a mile upstream of Fairview Beach and a large flock of swans in Passapatanzy Creek, which joins the Potomac River a mile upstream from Fairview Beach. Presumably these are the closest points to Fairview Beach at which a large number of birds have been seen. As discussed in **Section 2.4** of **Appendix B**, a sample taken in the Potomac River near the mouth of Passapatanzy Creek had an *Enterococci* concentration of 360 cfu/100 ml. In contrast, when FBRA analyzed samples collected in Passapatanzy Creek and in the Potomac River near the geese, the samples had *E. coli* concentrations of 100 and < 100 cfu/100 ml, respectively. In any case, since there is no barrier, like an island or deep channel, to prevent the flow from Passapatanzy Creek from mixing laterally into the mainstem Potomac River, it is unlikely that bacteria concentrations a mile away from Fairview Beach are transported close to shore and contribute significantly to bacteria concentrations at the beach.

VT (2007) suggests raccoons are the most likely source of bacteria from wildlife. Based on the MST, as shown in **Figure 3** of **Appendix B**, 13% of the bacteria observed at Fairview Beach could be attributed to wildlife. It is interesting to note that most of the isolates attributed to wildlife were identified in the first two years of the VT MST study. While overall 13% of the bacteria were attributable to wildlife, 31% of the bacteria were attributable to wildlife in 2004 and 2005, in contrast to 2006 and 2007, when only 7% and 12%, respectively, were attributable to wildlife. The explanation for these differences is not clear, though it may be a function of meteorological or hydrological conditions.

4.3.4 Potomac River

The Potomac River can be considered either a source or a transport path for bacteria at Fairview Beach.

Background bacteria concentrations at Fairview Beach stem from the Potomac River. VT's recent monitoring of *Enterococci* shows that generally bacteria concentrations in the Potomac River are low. Paired monitoring of near shore and sites farther out in the river by both VT and FBRA shows that bacteria concentrations tend to drop moving from the shore out into the river.

Potential human sources of bacteria occur upstream in the Washington DC metropolitan area. Both the District of Columbia and the City of Alexandria have combined sewer systems (CSS). The former is subject to a Long-Term Control Plan (LTCP) which will reduce the number and quantity of combined sewer overflows in the future; the LTCP for the City of Alexandria will be revised to achieve water quality improvements.

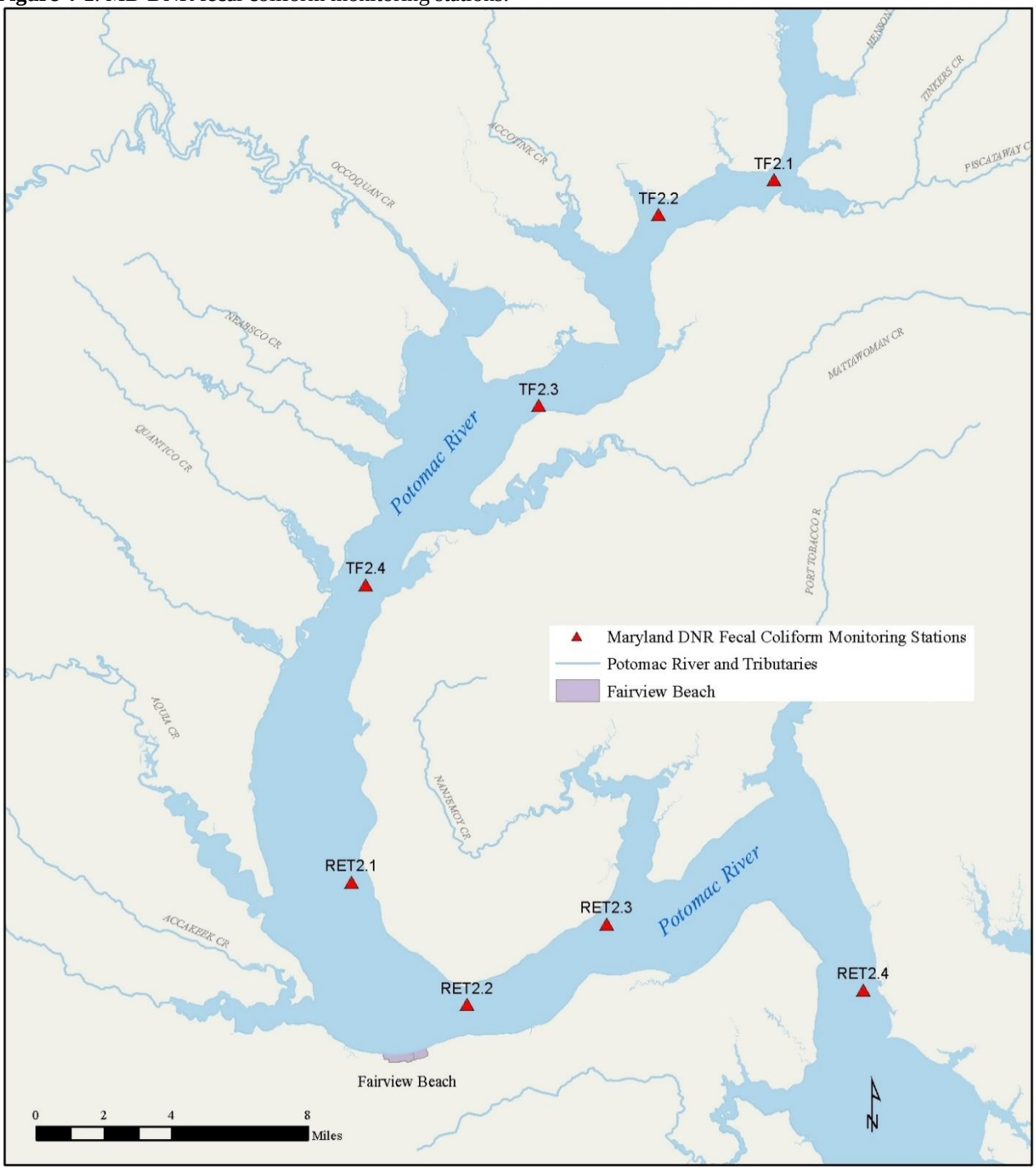
The impact of the Potomac River as a background source can be gauged by an analysis of fecal coliform monitoring data collected by the Maryland Department of Natural Resources (MD DNR). **Table 4-3** summarizes the observed fecal coliform concentrations in the Potomac River over the period 1986-1998. Monitoring stopped in 1998. The detection limit was 2 cfu/100 ml. **Figure 4-1** shows the location of the sampling stations. The stations closest to Fairview Beach are in the salinity transition zone: RET2.1, RET2.2, RET2.3, and RET2.4.

Table 4-3. Potomac River fecal coliform concentrations (cfu/100 ml), MD DNR, 1986-1998[1].

Station	Number of Samples	Arithmetical Mean	Geometrical Mean	Percent >200 cfu/100 ml	Percent >400 cfu/100 ml	Maximum
TF2.1	136	624	93	41%	28%	9,300
TF2.2	135	307	56	30%	21%	4,300
TF2.3	137	208	38	22%	12%	3,300
TF2.4	138	117	18	12%	8%	5,000
RET2.1	139	155	9	6%	4%	9,300
RET2.2	138	63	7	3%	3%	4,900
RET2.3	52	7	5	0%	0%	43
RET2.4	136	13	4	2%	1%	490

[1]Source: Chesapeake Bay Program Data Hub http://www.chesapeakebay.net/data/downloads/cbp_water_quality_database_1984_present, accessed 6/28/2014.

Figure 4-1. MD DNR fecal coliform monitoring stations.



As **Table 4-3** shows, there is a strong gradient in bacteria concentrations with elevated concentrations upstream in the Washington metropolitan area and diminishing concentrations in the salinity transition zone. Before a sufficient number of *E. coli* or *Enterococci* samples had been taken, a fecal coliform concentration of 400 cfu/100 ml was used by Virginia as the single sample maximum criterion followed in time by the *E. coli* single sample maximum criterion of 235 cfu/100 ml equivalent to the *Enterococci* single sample maximum criterion of 104 cfu/100 ml. As many as 28% of the samples had fecal coliform concentrations above 400 cfu/100 ml upstream of the transition zone, but in the

transition zone less than 5% of the samples exceeded the 400 cfu/100 ml criterion. Elevated bacteria concentrations occur far less frequently in the main channel of the Potomac River in the transition zone than at Fairview Beach, indicating that the Potomac River is not generally the source of the elevated bacteria concentrations observed at Fairview Beach or the large fraction of the bacteria attributable to human sources when concentrations are elevated.

4.3.5 Re-suspended Sediment and Beach Sand

Because elevated bacteria concentrations tend to occur under rough or muddy conditions, re-suspended sediment is a possible source of bacteria at Fairview Beach. The source of the bacteria in sediment is discussed below.

Recently, scientists have identified beach sand as a reservoir of fecal indicator bacteria, including *Enterococci* (Halliday and Gast 2011). Observed concentrations can be an order of magnitude more or greater in beach sand than tidal water, if the concentration in sand is measured as cfu/100g or cfu/100 ml volume. *Enterococci* find a hospitable environment in the biofilms surrounding sand particles, which provide sufficient moisture and nutrients while sheltering the bacteria from sunlight. Some researchers assert that *Enterococci* and other indicator bacteria are able to regenerate in sand, and that sand supports natural strains not directly derivable from any animal species (Whitman and Nevers 2003).

The beaches dynamically exchange sediments with the tidal water at their margins. In their review article, Halliday and Gast (2011) report that "[d]ata from nearly all environments suggest erosional flow conditions generated by storms or tides may flush bacteria out of sediments or sands, resulting in some level of contamination of the water column" (p. 9). Whitman and Nevers (2003), in their detailed study of an urban beach in Chicago, studied correlations between sand and water column bacteria concentrations and concluded that sand and water "were correlated, indicating a continued flux between sand and water…this flux has bidirectional components, but the net movement of *E. coli* is presumably from foreshore lakeward, driven by swash and re-suspension" (p. 5559). Halliday (2012), in a study of beaches at Providencetown, MA, found similar results for *Enterococci*: the flood tide transfers bacteria from sand to the water column, and the stronger the waves, the greater the transfer. Yamahara et al. (2007) in a study of a beach in Monterrey, CA found that even in the absence of erosion, *Enterococci* in beach sand can be mobilized or eluted by flood tide. The bacteria lost from the sand were roughly equivalent to the bacteria gained by the water column.

VT (2006 and 2007) found elevated concentrations of bacteria in sand in the vicinity of the outfall of the Pavilion Avenue drainpipe. It is not known how widespread elevated concentrations are in sand or whether high concentrations are confined to a few hotspots. The presence of bacteria in beach sand may also explain why FBRA observed elevated bacteria concentrations upstream of Fairview Beach under rough conditions, as shown in **Figure 10** of **Appendix B**.

The presence of *Enterococci* in beach sand may also explain the large fraction of bacteria attributable to birds at Fairview Beach. Since bacteria survive better in sand than in the water column, a small number of birds defecating in the sand can have a magnified impact. Bacteria from birds can be spread by beach traffic (Whitman and Nevers 2003), enhancing the opportunity for their transport to beach waters. If natural strains of *Enterococci* are present, they may confound the identification of isolates attributable to birds and wildlife, since they are likely not to have extensive exposure to antibiotics.

On the other hand, when FBRA volunteers attempted to measure the amount of bacteria on sediment by testing an agitated mixture of beach water and sediment, they failed to detect significant

bacteria concentrations with Coliscan kits (Cover et al. 2011). Concentrations of bacteria in sediment were low in the samples collected 20 ft. out along the beach by VDH and VT in November 2013, though no sediment sample was collected at the only site where water column bacteria concentrations were above 104 cfu/100 ml.

4.3.6 Stormwater

Stormwater has already been identified as a source of elevated bacteria concentrations by FBRA monitoring, as described in **Section 3.1** of **Appendix B**. Stormwater also carries suspended sediment in elevated concentrations and bacteria are likely transported in this sediment. Measured bacteria concentrations in sediment in intermittent streams sampled by VDH and VT in November 2013 ranged from 800 to 6,000 cfu/100 mg. This sediment may be deposited near shore and contribute to the bacteria re-suspended under rough or muddy conditions. In a study of the Neuse River Estuary, Fries et al. (2006) found 38% of the indicator bacteria attached to particulate matter and noted that this fraction was similar to fraction of bacteria attached to particulate matter in stormwater.

4.3.7 Groundwater

As stated earlier, the water table is relatively close to the surface in the soils underlying Fairview Beach, making them unsuitable for septic drainfields. Even well-functioning systems can transport bacteria to surface water. Groundwater may also be a conduit for bacteria from leaking or faulty sewer connections. On the other hand, the relatively few samples collected from groundwater have not verified that groundwater is a major conduit for bacteria. Significant bacteria concentrations have been observed at the water table by FBRA volunteers only immediately in the vicinity of the recently-installed drain from the parking lot, discussed in **Section 3.3** of **Appendix B**. Moreover, the fact that bacteria concentrations dropped and the detection of isolates from human sources ceased after the 8th Street sinkhole was filled in may indicate that subsurface flow is not a significant transport path for bacteria. This may also be indicated by the fact that bacteria concentrations are relatively low under calm conditions, when the influence of groundwater may be more significant.

4.3.8 Summary of Contributions of Sources and Transport Paths

Table 4-4 summarizes the evidence for and against potential sources contributing significantly to the bacteria problems at Fairview Beach. **Table 4-5** provides a similar summary for transport paths. The evaluation of the Potomac River's contribution has been included under sources.

Table 4-4. Summary of evidence for and against strength of contribution of sources to bacteria concentrations at Fairview Beach.

Sources	For	Against
Septic systems, sewers	MST; History of problems; Poor soils for septic systems	None
Boats	Large number of boaters on river in vicinity of Fairview Beach.	VT observed low bacteria concentrations during special events attracting large number of boaters.
Dogs and other pets	MST; VT reports of waste on beach	None
Birds and wildlife	MST; Large numbers of geese, swans 1 mile from beach; Large number of seagulls during off-season	No large populations of birds in vicinity of beach during swimming season; Bacteria concentrations 1 mile away are likely to be diluted.
Potomac River	Existence of CSS in DC and City of Alexandria; Upstream water impaired by stormwater, sanitary sewer overflows, and other urban sources.	VT generally observed low bacteria concentrations in mainstem Potomac River; Bacteria concentrations are lower farther from shore. Historical MD DNR sampling suggests elevated bacteria concentrations more frequent at Fairview Beach than mainstem Potomac River; DC bacteria model predicts upstream urban sources have little impact on Fairview Beach.

Table 4-5. Summary of evidence for and against strength of contribution of transport paths to bacteria concentrations at Fairview Beach.

Path	For	Against
Stormwater	FBRA sampling Nov-18-13 Sampling Scientific literature	None
Groundwater	Scientific literature	High subsurface concentrations found only in hot spots. Filling sinkhole decreased concentrations.
Re-suspended Sediment	Scientific literature High concentrations under rough conditions	FBRA sampling (**Section 3.2** of **Appendix B)** Low concentrations in 11/13 samples
Beach Sand	Scientific literature High concentrations under rough conditions	High subsurface concentrations found only in hot spots

The strength of the contribution of sources is best estimated using the MST analysis in **Section 2.1** of **Appendix B**. The existence of human sources has been independently verified, at least in part, by the identification of sewage disposal problems in the trailer park, and needless to say, Fairview Beach is no stranger to dogs and other pets. Birds may be the only source whose contribution as measured by the MST analysis may seem disproportionate to the size of the population able to impact bacteria concentrations at Fairview Beach during the swimming season. This may be because they disproportionally contribute to bacteria in beach sand, or are confounded with regenerated or natural bacteria in beach sand, as was earlier speculated.

Given the observed background bacteria concentrations in the mainstem Potomac River and the observed gradient of bacteria concentrations at Fairview Beach, it is unlikely that the Potomac River contributes significantly to the bacteria observed at the beach.

The transport path that delivers the largest bacteria load is probably local stormwater runoff. The strength of this path has been verified directly by FBRA sampling of storm events and by VT/VDH sampling of bacteria in sediment in intermittent channels in November, 2013. In order for runoff to contribute bacteria under rough conditions in dry weather, bacteria from runoff must be stored in a reservoir such as deposited sediment, or, perhaps through tidal action, in beach sand. Groundwater concentrations above the assessment threshold have been detected only in isolated hot spots, suggesting that in general groundwater is not a major transport path for bacteria. The contribution of beach sand to bacteria concentrations in the water column, while amply demonstrated in the scientific literature, has not been verified by direct measurement at Fairview Beach.

4.4 Conceptual Model of Bacteria Concentrations at Fairview Beach

Using the available monitoring data and the analysis of sources and transport paths, a conceptual model was developed to quantitatively link bacteria concentrations observed in the water column at Fairview Beach with potential sources and transport paths. The basic idea behind the conceptual model is to define two conditions for the impairment area/swimming area at Fairview Beach: 1) calm conditions, where there is no violation of water quality standards and 2) rough conditions, where water quality standards are violated. When there are calm conditions, bacteria are present from 1) background Potomac River, 2) groundwater, and 3) exchange with the beach sand (under low energy conditions). When there are rough conditions, the Potomac River and groundwater still contribute bacteria to the swimming area, but in addition 4) there is an exchange with beach sand under high energy conditions, and 5) bacteria are re-suspended from a "reservoir" of available bacteria. **Table 4-6** summarizes the transport paths for each condition.

Table 4-6. Transport paths under calm and rough conditions in impairment area.

Condition	Transport Path
Calm	Potomac river background Groundwater Low-energy exchange with beach sand
Rough	Potomac river background Groundwater High-energy exchange with beach sand Re-suspended bacteria

Although rough conditions can occur during storm events, they can also occur at other times through the action of winds or tides. Runoff, therefore, does not necessarily contribute bacteria directly under rough conditions. Runoff can contribute bacteria to the swimming area, however, by contributing bacteria to the reservoir that re-suspends under rough conditions. This reservoir can be thought of as deposited sediment that is re-suspended by the action of wind and waves, though the reservoir wouldn't necessarily have to be sediment itself: there could be some more complicated interaction between bacteria, sediment, and the water column, including interactions with bacteria in beach sand.

The VDH monitoring data can be used to estimate the average bacteria concentrations for calm and rough conditions. Assuming that exceedances of the assessment threshold primarily occur if and only if rough conditions are prevalent, the geometric mean of *Enterococci* concentrations less than 104 cfu/100 ml can be used to estimate the average bacteria concentration under calm conditions, while the geometric mean of concentrations greater than 104 cfu/100 ml provides an estimate of average concentrations under rough conditions. **Table 4-7** shows the results. Moreover, the background contribution to bacteria

concentrations from the Potomac River can be calculated from data collected by VT 25 meters farther out than the VDH monitoring locations. Using the results shown in **Table 5** of **Appendix B**, bacteria concentrations from samples 25 meters out are approximately 40% of the concentrations observed at VDH monitoring stations, so background concentrations from the Potomac River are set at 40% of the concentrations for calm conditions, as shown in **Table 4-7**.

Table 4-7. Estimated concentrations and source contributions under calm and rough conditions.

Condition	*Enterococci* Concentration (cfu/100 ml)	Bird	Human	Pet	Wildlife
Background[1]	12	75%	5%	11%	9%
Calm[2]	30	39%	18%	14%	29%
Rough[3]	300	41%	26%	22%	11%

Sources:
[1] Based on VT Measurements at 25 meters from beach
[2] Based on VDH observations less than 104 cfu/100 ml
[3] Based on VDH observations greater than 104 cfu/100 ml

Since MST results are also available for 1) VDH *Enterococci* samples with concentrations less than 104 cfu/100 ml, 2) VDH *Enterococci* samples with concentrations greater than 104 cfu/100 ml, and 3) VT samples taken 25 meters beyond the VDH sampling locations, the contribution of each source (human, pets, wildlife, and waterfowl) to the bacteria concentrations for calm conditions, rough conditions, and background can also be estimated. These are also shown in **Table 4-7**.

In addition, the percent contribution of sources in the transport paths contributing bacteria under calm conditions can be determined by subtracting the background contribution of sources from the percent contribution of sources under calm conditions. In a similar manner, the percent contribution in the transport paths contributing bacteria under rough conditions can be determined by subtracting the contribution of sources under calm conditions from their percent contribution under rough conditions. The contribution of sources to calm and rough transport paths are shown in **Table 4-8**. The contribution of sources to individual transport paths, such as groundwater, runoff, and the exchanges with beach sand, cannot be determined with the existing data and will be assumed to be equal to the overall contribution under rough and calm conditions.

Table 4-8. Contribution by source to transport paths under calm and rough conditions.

	Percent of *Enterococci*			
Transport Paths	Bird	Human	Pet	Wildlife
Calm	15%	27%	15%	42%
Rough	41%	27%	23%	9%

4.4.1 Fairview Beach Watershed Model

A simple watershed model was developed to estimate bacteria loads in runoff and groundwater from local sources. Average annual bacteria loads are determined as the product of average annual flow and estimates of bacteria concentrations in runoff and groundwater based on observed monitoring data.

4.4.1.1 Simulated Flow

Simulated flows were calculated based on the land use acreage calculated in **Section 2.4** and per acre simulated flow from the Chesapeake Bay Program's Phase 5.3.2 (P532) Watershed Model (EPA 2010). Average annual runoff, interflow, and baseflow were taken from P532 land uses in the land segment representing King George County (A51099). The averaging period was 1991-2000, which is the hydrological averaging period for the Chesapeake Bay Program. Land uses in P532 are simulated on a per acre basis and reported in inches**. Table 4-9** gives the average annual simulated flow in runoff, interflow, and baseflow for King George County land uses. **Table 4-10** gives the average annual flows by land use and sub-watershed.

Table 4-9. Average annual simulated flow (in) from King George County land uses in the P532 Watershed Model.

Land Use	Runoff	Interflow	Baseflow
Pervious Developed	2.59	7.20	11.63
Impervious Developed	35.63	N/A	N/A
Forest	0.62	6.02	14.65

Table 4-10. Average annual simulated flow (acre-ft) in Fairview Beach sub-watersheds.

Sub-watershed	Runoff	Interflow	Baseflow	Total
Lower Fairview Beach	249	28	46	323
Upper Fairview Beach	95	339	793	1,228
Total Fairview Beach	**344**	**368**	**839**	**1,551**
Lower Potomac Landing	43	35	56	135
Upper Potomac Landing	27	112	267	406
Total Potomac Landing	**70**	**147**	**324**	**541**

4.4.1.2 Bacteria Loads

The average concentration of bacteria in stormflow was estimated from observations by FBRA (**Table 12** of **Appendix B**) to be 1,800 cfu/100 ml (*E. coli*). Stormflow includes both runoff and interflow components from the model.

A groundwater concentration was not explicitly estimated in the conceptual model but can be assumed to be roughly equivalent to the local contribution to beach bacteria concentrations under calm conditions, or 18 cfu/100 ml (*Enterococci*) (See **Table 4-7**).

The average stromwater concentration is in *E. coli* bacteria and needs to be converted to *Enterococci* bacteria. It will also be useful to have estimates of bacteria loads in terms of both fecal coliform bacteria. To estimate fecal coliform loads the stormwater concentration in *E coli* bacteria was converted to fecal coliform bacteria using the standard Virginia translation equation (**Eq. 4-1**)

$$\log_2(E\ coli) = -0.0172 + 0.91905 * \log_2(\text{fecal coliform}) \qquad \textbf{Eq. 4-1}$$

According to this equation, the fecal coliform concentration in stormwater is approximately 3530 cfu/100 ml. To convert between *Enterococci* and fecal coliform bacteria, an equation was fitted between the geometric mean criteria and the single sample thresholds (**Eq. 4-2**).

$$Enterococccci = A * \text{Fecal Coliform}^{B} \qquad \textbf{Eq. 4-2}$$

The fitted values for A was approximately 0.0085 and the value for B was 1.57. Using these values, the fecal coliform baseflow concentration was set at approximately 131 cfu/100 ml and the *Enterococci* stormflow concentration was set at 3,180 cfu/100 ml. These concentrations were used for both Fairview Beach and Potomac Landing, although there is no monitoring data for the Potomac Landing watershed, and it is unlikely that bacteria concentrations found in stormwater there are as high as Fairview Beach.

Table 4-11 shows the resulting average annual loads.

Table 4-11. Average annual bacteria loads from Fairview Beach sub-watersheds.

	Fecal Coliform (cfu/year)			*Enterococci* (cfu/year)		
Sub-watershed	Surface	Subsurface	Total	Surface	Subsurface	Total
Lower Fairview Beach	1.21E+13	7.41E+10	1.21E+13	1.09E+13	1.02E+10	1.09E+13
Upper Fairview Beach	1.89E+13	1.28E+12	2.02E+13	1.71E+13	1.76E+11	1.72E+13
Total Fairview Beach	**3.10E+13**	**1.36E+12**	**3.24E+13**	**2.79E+13**	**1.86E+11**	**2.81E+13**
Lower Potomac Landing	3.41E+12	9.12E+10	3.51E+12	3.08E+12	1.25E+10	3.09E+12
Upper Potomac Landing	6.03E+12	4.32E+11	6.46E+12	5.44E+12	5.93E+10	5.49E+12
Total Potomac Landing	**9.45E+12**	**5.23E+11**	**9.97E+12**	**8.51E+12**	**7.18E+10**	**8.58E+12**

These loads can be divided into sources according to the percentages attributable to birds, pets, wildlife, and human sources under calm and rough conditions as shown in **Table 4-8**. **Table 4-12** shows the loads by source in terms of *Enterococci* bacteria, and **Table 4-13** shows the loads by source in terms of fecal coliform bacteria.

Table 4-12. Average annual fecal coliform loads (cfu/year) from Fairview Beach sub-watersheds by source.

Sub-watershed	Bird	Human	Pet	Wildlife	Total
Lower Fairview Beach	4.97E+12	3.29E+12	2.79E+12	1.12E+12	1.22E+13
Upper Fairview Beach	7.94E+12	5.45E+12	4.54E+12	2.24E+12	2.02E+13
Total Fairview Beach	**1.29E+13**	**8.74E+12**	**7.33E+12**	**3.36E+12**	**3.23E+13**
Lower Potomac Landing	1.41E+12	9.45E+11	7.98E+11	3.45E+11	3.50E+12
Upper Potomac Landing	2.54E+12	1.74E+12	1.45E+12	7.24E+11	6.46E+12
Total Potomac Landing	**3.95E+12**	**2.69E+12**	**2.25E+12**	**1.07E+12**	**9.97E+12**

Table 4-13. Average annual *Enterococci* loads (cfu/year) from Fairview Beach sub-watersheds by source.

Sub-watershed	Bird	Human	Pet	Wildlife	Total
Lower Fairview Beach	4.47E+12	2.95E+12	2.51E+12	9.85E+11	1.09E+13
Upper Fairview Beach	7.04E+12	4.66E+12	3.96E+12	1.61E+12	1.73E+13
Total Fairview Beach	**1.15E+13**	**7.58E+12**	**6.44E+12**	**2.59E+12**	**2.81E+13**
Lower Potomac Landing	1.26E+12	8.35E+11	7.10E+11	2.82E+11	3.09E+12
Upper Potomac Landing	2.24E+12	1.48E+12	1.26E+12	5.15E+11	5.50E+12
Total Potomac Landing	**3.50E+12**	**2.32E+12**	**1.97E+12**	**7.96E+11**	**8.58E+12**

4.4.2 Validation of the Fairview Beach Conceptual Model

Two cross-checks were performed to help validate that the conceptual model can explain the bacteria concentrations observed at Fairview Beach. First, a source assessment was performed using the standard methods used in Virginia's bacteria TMDLs to determine if the sources identified in the

conceptual model are sufficient to explain the observed bacteria concentrations in runoff and the MST results from observations taken at the beach. Second, order of magnitude estimates of the trapping efficiency and decay rate in the hypothesized bacteria reservoir were calculated to check if under the conceptual model sufficient bacteria are generated locally to explain the rise in bacteria concentrations at the beach under rough conditions.

4.2.4.1 Source Assessment Based on Estimated Animal Populations

Table 4-12 and **Table 4-13** estimate the contribution of sources to bacteria loads based on the results of bacteria monitoring data and MST. Another way to determine the contribution of sources is by calculating the bacteria generated by species of pets, wildlife, and birds. Pet and wildlife populations and the resulting annual bacteria production were estimated using the standard methods employed in bacteria TMDLs in Virginia. The assumption used in the TMDLs for Holmes Run, Cameron Run, and Hunting Creek (DEQ 2010b) were adopted, with minor modifications.

No observations of geese have been reported in the Fairview Beach or Potomac Landing watersheds, so geese were not considered in the analysis. Similarly, the small steep (and intermittent) streams found in the vicinity of Fairview Beach are not ideal beaver habitat, so beaver were also not considered in the analysis. Otherwise, the calculation of populations and bacteria production closely follows the assumptions of the Hunting Creek TMDL.

Table 4-14 shows the habitat for each type of animal used to estimate wildlife populations. The table also cites the original study or authority for the habitat assumptions used in the Hunting Creek TMDLs. **Figure 2-2** shows the rivers and streams used to estimate duck and muskrat habitat. The Potomac River shoreline was not used to estimate populations of ducks and muskrats. Pet populations are estimated based on the number of households, as also shown in **Table 4-14**. **Table 4-15** shows the populations calculated based on the information in **Table 4-14**.

Table 4-14. Population and habitat requirements for wildlife and pets.

Type	Population Density	Habitat Requirements
Deer[1]	0.12 animals/acre	Entire watershed
Raccoon[1]	0.31 animals/acre	Entire watershed
Muskrat[3]	2.0 animals/acre	Within 30 ft. of streams and ponds (urban, grassland, forest, wetlands)
Duck[1]	0.06 animals/acre	Within 300 ft. of streams and ponds (urban, grassland, forest, wetlands)
Dog[2]	0.58/ household	N/A
Cat[2]	0.66/ household	N/A

Sources:
[1]Lower Accotink Creek Bacteria TMDL (DEQ 2008)
[2]American Veterinary Medical Association (2007)
[3]personal communication, C. Smith, Fairfax County Park Authority (4/23/2009)

Table 4-15. Wildlife and pet populations in Fairview Beach and Potomac Landing watersheds.

Type	Fairview Beach	Potomac Landing
Deer	97	35
Raccoon	251	91
Muskrat	36	24
Duck	18	7
Dog	196	34
Cat	223	38

Table 4-16 shows the assumed daily fecal coliform bacteria production rate per animal for the populations estimated. This table also includes citations for the original study or authority for the production rates adopted in the Hunting Creek TMDLs. **Table 4-17** shows the resulting annual fecal coliform production rate by species. According to these calculations, dogs are the dominant source of bacteria among wildlife and pets. Since ducks are the only birds considered in this analysis, the contribution from birds is likely to be underestimated.

Table 4-16. Fecal coliform production rates per animal.

Type	Daily Fecal Production (cfu/day)
Deer[1]	3.47E+08
Raccoon[1]	1.13E+08
Muskrat[1]	2.50E+07
Duck[2]	5.30E+05
Dog[3]	1.85E+09
Cat[3]	2.98E+08

Sources:
[1]Lower Accotink Creek Bacteria TMDL (DEQ 2008)
[2]James River and Tributaries-City of Richmond (DEQ 2010a)
[3]Accotink Creek Bacteria TMDL (Moyer and Hyer 2003)

Table 4-17. Average annual fecal coliform production by species in Fairview Beach and Potomac Landing watersheds.

Type	Fairview Beach	Potomac Landing
Deer	1.23E+13	1.28E+10
Raccoon	1.04E+13	8.30E+10
Muskrat	3.29E+11	4.38E+11
Duck	3.48E+09	1.92E+11
Dog	1.32E+14	2.27E+13
Cat	2.43E+13	4.16E+12
Total	1.80E+14	2.76E+13

Table 4-17 represents the total bacteria produced and deposited on the land surface or directly in streams.

The bacteria production rate in **Table 4-17** does not take into account human sources, which, according to the analysis of MST results, may represent a quarter of the total bacteria load. An estimate of the number of human sources, such as straight pipes, failing septic systems, faulty sewer connections, or leaking sewer lines, is not currently available, but, as discussed in **Section 2.2.3** of **Appendix B**, failing septic systems and broken sewer lines have been identified in the trailer park by Pavilion Drive, while genetic fingerprinting on samples taken in November 2013 along 6th Street demonstrate that the impact of human sources is not confined to the trailer park.

Most of the bacteria deposited on land are not expected to reach streams or the Potomac River. Comparing the total bacteria loads in **Table 4-11** and **Table 4-17**, it would appear that approximately 13% of the bacteria load generated by pets, birds, and wildlife is transported in streams or stormwater runoff. In contrast, in Holmes Run, only 3% of the load deposited on land reached streams. The delivery ratio between bacteria produced and bacteria transported in the water should be larger for a smaller watershed, however, because of shorter travel times. As mentioned earlier, it is likely that the

contribution of birds has been underestimated, so the load generated by birds, pets, and wildlife in Fairview Beach is larger than shown in **Table 4-17** and consequently, the delivery ratio is smaller.

The source assessment indicates that estimated animal and pet populations in the Fairview Beach and Potomac Landing watersheds are sufficient to generate the bacteria loads estimated in the watershed model. The one puzzle is explaining the population of birds necessary to generate their contribution to the bacteria loads in surface and subsurface flow. The population-based source assessment will not be used in the watershed plan, and the relative contribution of pets, wildlife, birds and human sources will be based on the MST analysis.

The bacteria loads in **Table 4-17** do not take into account waterfowl in and along the Potomac River. As many as 300 seagulls have been observed on the docks in the vicinity of Fairview Beach from September to March, but very few are seen during the swimming season. It is not likely, therefore, that direct deposition from seagulls contributes to the bacteria concentrations observed May through September. The concentration of bacteria in seagull feces have been reported as 1E+6 to 1E+10 cfu/g for fecal coliform and 2.0E+4 to 2.4E+8 cfu/g for *Enterococci*.

Given the reported range of feces production rates for seagulls, 11.2 g/d to 24.9 g/d, total fecal coliform bacteria production during the winter could be as large as 8.2E+13 cfu/day, though it is likely to be several order of magnitudes smaller, given the range of the observed concentration in gull feces (Fogarty et al. 2003). Much of the feces remains on the docks (personal communication, J. Harrover, 6/18/2014), where it is subject to high rates of decay, but some of it may enter the water column and contribute to the reservoir of bacteria responsible for high concentrations under rough conditions.

4.4.2.2 Checking the Validity of the Reservoir Hypothesis

The conceptual model postulates the increase in bacteria concentrations under rough conditions is due to the re-suspension of bacteria from a reservoir. This reservoir could be re-suspended sediment, beach sand in the swash zone, or perhaps a more complicated mechanism. The key points in the reservoir hypothesis are not the exact mechanisms but that the addition of bacteria to the reservoir by local sources is sufficient to explain the observed increase in concentrations under rough conditions.

Representing re-suspended bacteria as a first-order reservoir is a way of connecting observed concentrations in the water column at the beach to estimates of bacteria loads in runoff and other local sources. It checks whether the assumptions are reasonable and the estimated loads are the right order of magnitude. The rate of change of bacteria in the reservoir is represented by **Eq. 4-3** if re-suspended bacteria are modeled as a linear reservoir with a first-order decay or loss rate.

$$dS/dt = -k*S + L_r \qquad \textbf{Eq. 4-3}$$

where
k = loss rate (day $^{-1}$)
L_r = average daily bacteria load added to the reservoir from runoff and other sources (cfu/day)
S = bacteria load stored in reservoir (cfu)

Assuming in the long-term that the reservoir is in equilibrium (dS/dt = 0), then (**Eq. 4-4**)

$$k*S = L_r \qquad \textbf{Eq. 4-4}$$

The daily loading rate, L_r, can be approximated by dividing the average annual bacteria load in runoff (R) from **Table 4-11** by 365 and applying a trapping efficiency (t) to the daily load (**Eq. 4-5**):

$$L_r = t*R/365 \qquad \textbf{Eq. 4-5}$$

The bacteria load stored in the reservoir, S, has to be large enough to raise the concentration in the swimming area by 270 cfu/100 ml. This can be calculated by assuming, for Fairview Beach, that the beach is 5,750 ft. (1,750 meters) long, and by assuming that the volume impacted area runs 25 meters from shore to a depth of approximately 1.0 meters. The volume impacted then forms a triangular wedge of approximately 22,000 cubic meters. It requires approximately 6E+10 cfu to raise the bacteria concentration in this volume by 270 cfu/100 ml.

From **Table 4-11**, the average daily bacteria load from runoff is about 7.6 E+10 cfu/day. Decay rates in sediment are an order of magnitude smaller than the water column. A typical value might be 0.02/day. The trapping efficiency, t, would only have to be approximately 1-2% to provide sufficient bacteria to the reservoir to raise the bacteria concentrations by 270 cfu/100 ml. Therefore, local bacteria loads in runoff are sufficient to maintain a reservoir of bacteria capable of raising bacteria concentrations to 300 cfu /100 ml during rough conditions. **Table 4-18** summarizes the calculations used to cross check the reservoir hypothesis.

Table 4-18. Calculations for cross-checking reservoir hypothesis.

S	Shoreline length	1,750 meters
	Depth at 25 meters from shore	1 meter
	Wedge-shaped water volume from shore to 25 meters (1750 * 25 * 0.5)	22,000 cubic meters
	Difference in bacteria concentration between calm and rough conditions	270 cfu/100 ml
	Bacteria increase in wedge-shape volume under rough conditions	6 E+10 cfu
R	Average annual bacteria load in runoff	2.8 E+13 cfu/year
	Average daily bacteria load in runoff	7.6 E+10 cfu/day
k	Typical bacteria decay rate in sediment	0.02/day
t	Calculated trapping efficiency (365 * k * S / R)	0.016

4.5 Reductions Required to Meet the Water Quality Standard

According to the conceptual model of bacteria at Fairview Beach described in **Section 4.4.1**, 1) bacteria concentrations exceed the 104 cfu/100 ml assessment threshold only during rough conditions, and 2) typical bacteria concentrations under rough conditions are about 300 cfu/100 ml. Typically concentrations under rough conditions need to be reduced by about 65% to bring typical concentrations below the assessment threshold. Concentrations under calm conditions are typically 30 cfu/100 ml, including background concentrations from the Potomac River. If reductions are to be obtained only from sources and transport path contributing bacteria under rough conditions, the reductions in these sources would have to be 73%.

4.6 Approach to Achieving Necessary Load Reductions

The total bacteria load for all sources in the Fairview Beach sub-watersheds is 3.67E+13 (*Enterococci* cfu/year). **Table 4-19** shows the *Enterococci* loads by source (bird, human, pet, and

wildlife) for subsurface and surface flows for the plan area. These numbers were generated utilizing the information presented in **Table 4-8** and **Table 4-11**.

Table 4-19. Surface and subsurface bacteria loads by source.

	Surface *Enterococci* (cfu/year)				Suburface *Enterococci* (cfu/year)			
Sub-watershed	Bird	Human	Pet	Wildlife	Bird	Human	Pet	Wildlife
Lower Fairview Beach	4.47E+12	2.94E+12	2.51E+12	9.81E+11	1.53E+09	2.75E+09	1.53E+09	4.28E+09
Upper Fairview Beach	7.01E+12	4.62E+12	3.93E+12	1.54E+12	2.64E+10	4.75E+10	2.64E+10	7.39E+10
Total Fairview Beach	**1.14E+13**	**7.53E+12**	**6.42E+12**	**2.51E+12**	**2.79E+10**	**5.02E+10**	**2.79E+10**	**7.81E+10**
Lower Potomac Landing	1.26E+12	8.32E+11	7.08E+11	2.77E+11	1.88E+09	3.38E+09	1.88E+09	5.25E+09
Upper Potomac Landing	2.23E+12	1.47E+12	1.25E+12	4.90E+11	8.90E+09	1.60E+10	8.90E+09	2.49E+10
Total Potomac Landing	**3.49E+12**	**2.30E+12**	**1.96E+12**	**7.66E+11**	**1.08E+10**	**1.94E+10**	**1.08E+10**	**3.02E+10**
Total	**1.49E+13**	**9.83E+12**	**8.37E+12**	**3.28E+12**	**3.87E+10**	**6.96E+10**	**3.87E+10**	**1.08E+11**

The necessary reduction in bacteria loads can be achieved by removing all human and pet sources of bacteria transported in surface and subsurface waters and half of the remaining sources (i.e. bird and wildlife) transported in the surface runoff (**Table 4-20**). With these reductions, the total load for all sub-watersheds and sources is 9.25E+12 cfu/year of *Enterococci*, a 75% reduction from existing conditions (**Table 4-21**).

Table 4-20. Percent reductions in bacteria loads necessary by source and transport path to achieve water quality goals.

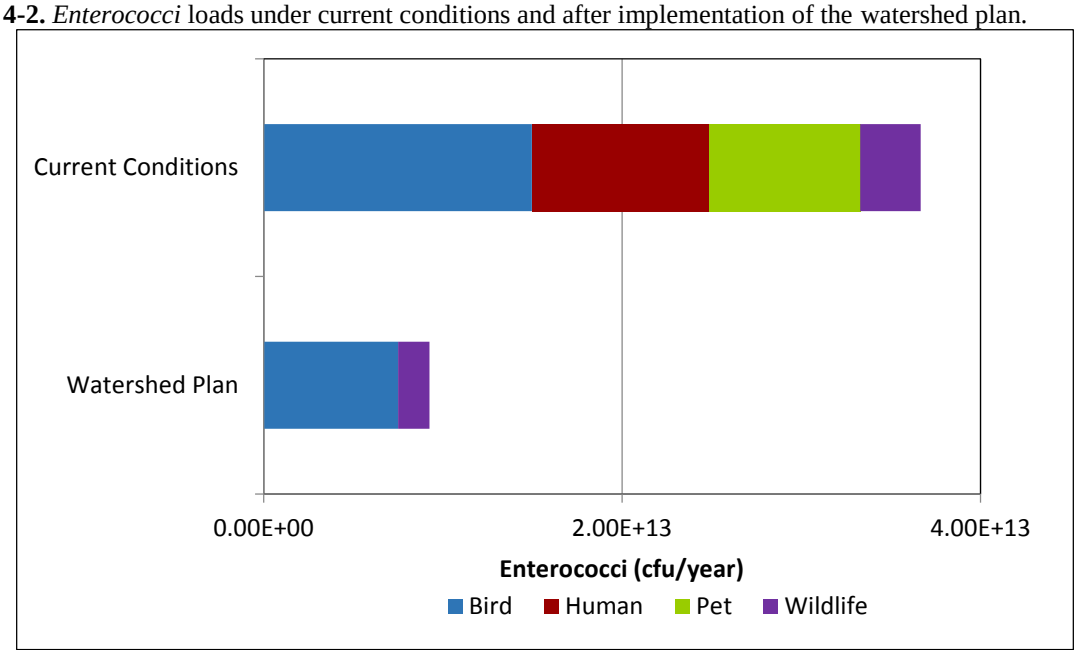
	Bird	Human	Pet	Wildlife
Surface	50%	100%	100%	50%
Sub-Surface	0%	100%	100%	0%

Table 4-21. Estimated surface and subsurface bacteria loads by source after proposed load reductions.

	Surface *Enterococci* (cfu/year)				Subsurface *Enterococci* (cfu/year)			
Sub-watershed	Bird	Human	Pet	Wildlife	Bird	Human	Pet	Wildlife
Lower Fairview Beach	2.23E+12	0	0	4.91E+11	1.53E+09	0	0	4.28E+09
Upper Fairview Beach	3.51E+12	0	0	7.70E+11	2.64E+10	0	0	7.39E+10
Total Fairview Beach	**5.72E+12**	**0**	**0**	**1.26E+12**	**2.79E+10**	**0**	**0**	**7.81E+10**
Lower Potomac Landing	6.31E+11	0	0	1.39E+11	1.88E+09	0	0	5.25E+09
Upper Potomac Landing	1.12E+12	0	0	2.45E+11	8.90E+09	0	0	2.49E+10
Total Potomac Landing	**1.74E+12**	**0**	**0**	**3.83E+11**	**1.08E+10**	**0**	**0**	**3.02E+10**
Total	**7.46E+12**	**0**	**0**	**1.64E+12**	**3.87E+10**	**0**	**0**	**1.08E+11**

Enterococci loads under current conditions and after implementation of the watershed plan are shown in **Figure 4-2**.

Figure 4-2. *Enterococci* loads under current conditions and after implementation of the watershed plan.



Chapter 5 discusses how bacteria reductions from sources and transport paths contributing to bacteria concentrations under rough conditions are to be achieved under the Fairview Beach Watershed Plan.

5 Management Measures

As a result of significant monitoring and analysis (**Chapter 4 and Appendix B**) and working with local stakeholders (**Chapter 3**), a series of management measures were identified that achieve the necessary load reductions at Fairview Beach. This section describes the existing and proposed BMPs. Background information is provided for each of the proposed measures followed by a description or estimation of anticipated load reductions. Critical areas for implementation of proposed measures are described and mapped, where possible. Required permits and reviews are also documented. The agency/agencies responsible for taking the lead in acquiring funding and implementing the proposed projects are then described. The multiple components are included to facilitate timely implementation of the plan and adherence to all necessary rules and regulations.

5.1 Existing BMPs

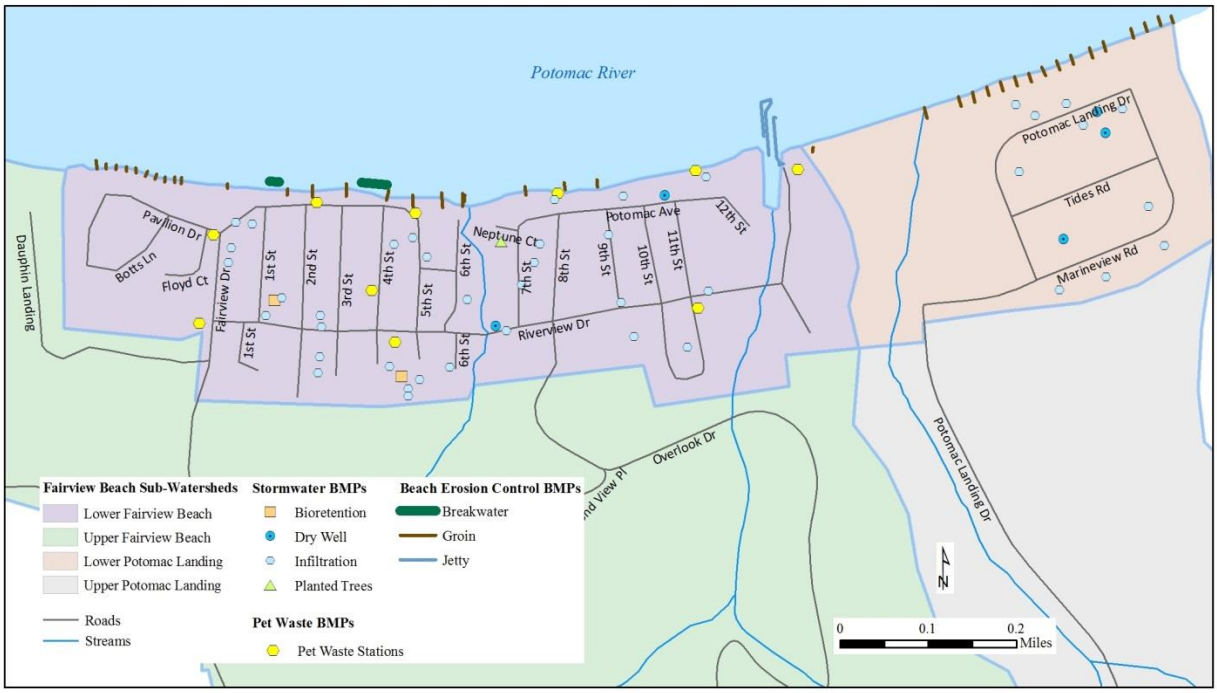
A number of management measures are already implemented in the plan area including BMPs for pet waste, beach erosion control, and education (**Figure 5-1**).

Beach erosion structures.

Ten pet waste stations were installed in 2011 in the Lower Fairview Beach sub-watershed by the TCCSWCD. The FBRA maintains the stations. Bacteria load reductions associated with the pet waste stations are estimated in **Section 5.3.1**. A series of groins and breakwater structures are also in place to protect the beach from erosion. The effects of these structures on bacteria concentrations is difficult to estimate. Educational efforts are underway to increase awareness and promote sound environmental stewardship. These efforts include 1) educating new residents of recommended pet waste disposal, 2) installing signs to increase awareness of the eroding bluff, and 3) displaying signs to remind beach visitors of proper pet waste disposal measures. Although these measures are not directly associated with bacteria load reductions, they are essential to the successful implementation of numerous other measures.

Stormwater BMPs have also been successfully installed in the plan area (**Figure 5-1**). The King George County Comprehensive Plan (King George County 2013) requires stormwater BMPs to be installed on properties with greater than 16% impervious cover, a CBPA Overlay Zoning District threshold. To date, 36 stormwater BMPs have been installed in the Lower Fairview Beach sub-watershed and 13 in the Lower Potomac Landing watershed. Measures installed in the Lower Fairview Beach sub-watershed include bioretention, dry wells, infiltration BMPs, and planted trees. Dry wells and infiltration BMPs were installed in the Potomac Landing sub-watershed. Load reductions associated with existing stormwater BMPs are provided in **Section 5.4.1**.

Figure 5-1. Locations of existing BMPs in the Fairview Beach plan area.



Despite these activities, a series of additional management measures will be required to achieve the necessary bacteria load reductions. The stakeholder-driven plan for achieving the necessary reductions is described below.

5.2 BMPs to Address Human Sources

A primary goal of this effort is to eliminate the human sources of bacteria in the plan area. Potential human sources of bacteria include the public sewer system, private septic systems, and boat wastewater systems. A number of activities are proposed to eliminate bacteria contributions from these sources, discussed below.

Problems are known to exist with the lateral connections to the public sewer system (Burkett 2002). The first step to addressing the problem is identifying leaking laterals using dye or smoke testing. Any leaks or problems with the public sewer system are governed by the VPDES permit for the Fairview Beach Wastewater Treatment Plant and should be addressed by the KGSA. Sewer problems on private property require repairs by the land owner, with assistance as available.

Fixing the septic systems in the plan area includes a multi-pronged approach. A couple of active septic systems in the KGSA service area are known to exist. These properties should be connected to the public sewer. The historically problematic septic systems in the trailer park (Burkett 2002) will be required to hook up to the public sewer when re-development occurs under new zoning for multi-unit dwellings. However, there is no assurance of when this will happen. In the meantime, the existing septic problems need to be addressed. To this end, the failing septic systems in the trailer park should be identified through dye testing. Records of previous testing efforts are available to assist with this effort (e.g. Burkett 2002). Once identified, septic problems need to be addressed as appropriate to include either repairing the existing system or installation of an alternative on-site septic system. Further, active septic systems, within and outside of the trailer park, are required to be pumped out every five years in

accordance with the King George Zoning Ordinance Chesapeake Bay Act provisions. This requirement should be enforced to ensure the functionality of septic systems throughout the plan area. Old or unused septic tanks are also suspected to exist throughout the plan area, although records of their locations are not available. The locations of these tanks should be identified, and the systems properly pumped and closed.

Potomac River boaters frequent the Fairview Beach area. The boat waste pump-out station at the marina needs to be properly maintained to encourage the responsible disposal of associated wastewater. In addition, a boat that collects waste from other boats during high traffic times will promote responsible waste disposal[2].

5.2.1 Anticipated Load Reductions

Through the implementation of the measures described above and the complementary education measures described in **Section 5.5**, human sources of bacteria will be eliminated in the Fairview Beach sub-watershed (**Table 5-1**). Problems in the sewer system will be identified and fixed. Septic tanks will either be fixed and properly maintained or hooked up to the sewer system. Boat waste will be disposed of properly. Removing the human sources of bacteria in the Fairview Beach sub-watersheds will result in an overall load reduction of 9.9E+12 cfu/year of *Enterococci* in the plan area (**Table 4-19**).

Table 5-1. Bacteria removal efficiency of management measures to control human sources.

Measure	Source	Units for Tracking	Efficiency %	Reference
Improve sewer system by finding and fixing leaking laterals using dye/smoke testing	Sewer	System	100	James River IP*
Dye test septic systems in the trailer park to determine which ones are failing	Septic	System	N/A	N/A
Pump and close old/unused septic tanks (RB-2, only in connection with concurrent sewer connection)	Septic	System	100	Piankatank IP
Hook up remaining septic users to sewer (RB-2)	Septic	System	100	Piankatank IP
Address flooding drainfields	Septic	System	100	James River IP*
Repair workable septics (RB-3)	Septic	System	95	Piankatank IP
Septic tank pump-out (RB-1)	Septic	System	10	Piankatank IP
Alternative on-site septic system (RB-5)	Septic	System	99	Piankatank IP
Ensure that boat pump-out station at marina is maintained in working order	Boat	System	100	Piankatank IP
Boat that collects waste from other boats during high traffic times	Boat	System	100	adapted from Piankatank IP, similar to marina-based pump-out

*http://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/ImplementationPlans/jamesricip.pdf, accessed 6/28/2014.

5.2.2 Critical Areas

Critical areas for implementation of BMPs to address human sources of bacteria are shown in **Table 5-2** and **Figure 5-2**. Public sewer system repairs will focus within the KGSA boundary, except when testing for interconnections with other areas such as the trailer park. Addressing septic system

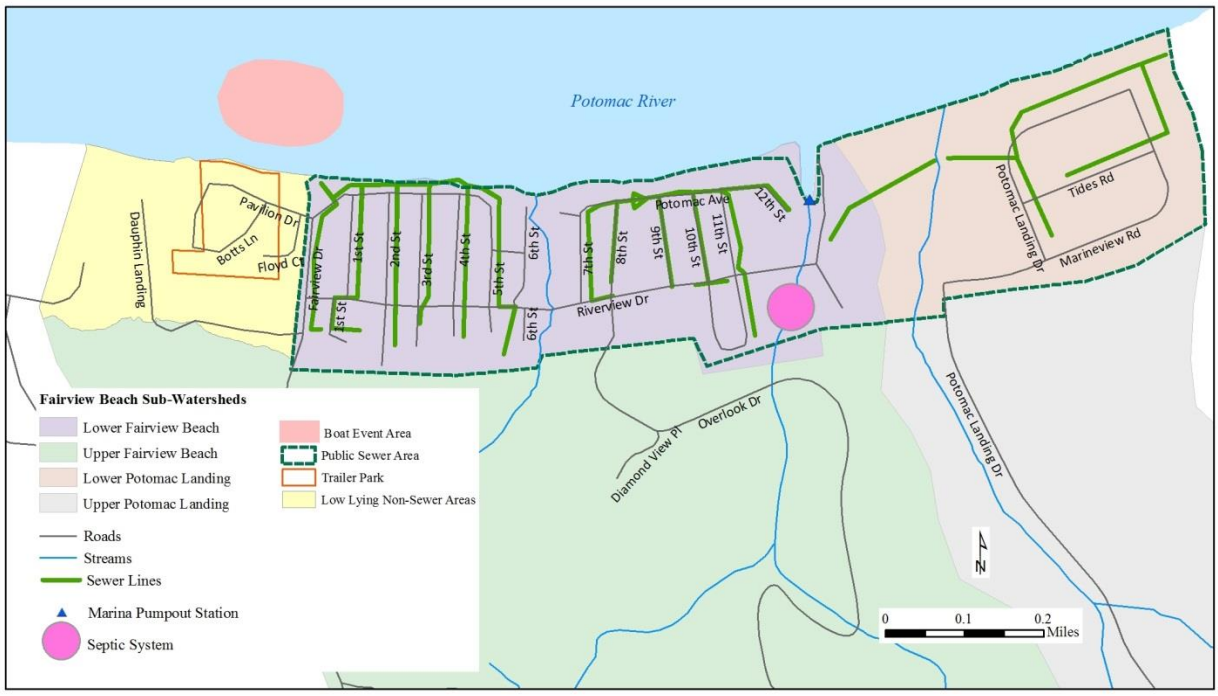
[2] e.g. Smith Mountain Lake, http://sml.us.com/royal-flush/, accessed 6/2/14.

issues will predominantly focus on areas outside of the KGSA boundary; however, a few instances of septic systems within the service boundary must be addressed. Boat measures will focus on high traffic boat areas on the water and at the Fairview Beach marina.

Table 5-2. Locations for implementation of management measures to address human sources of bacteria.

Measure	Location for Implementation
Improve sewer system by finding and fixing leaking laterals using dye/smoke testing	KGSA sewer system
Dye test septic systems in the trailer park to determine which ones are failing	Trailer park
Ensure that boat pump-out station at marina is maintained in working order	Marina pump-out station
Boat that collects waste from other boats during high traffic times	Potomac River near Fairview Beach
Pump and close old/unused septic tanks (RB-2, only in connection with concurrent sewer connection)	Inside sewer service area
Hook up remaining septic users to sewer (RB-2)	Near existing sewer lines
Address flooding drainfields	Low-lying areas outside of current sewer service boundary
Repair workable septics (RB-3)	Outside KGSA boundary
Septic tank pump-out (RB-1)	Locations with septic
Alternative on-site septic system (RB-5)	Outside KGSA boundary

Figure 5-2. Areas for implementation of BMPs to control human sources.



5.2.3 Necessary Permits and Review

No permits are required for KGSA to test the public sewer system; however, hooking up to the sewer system requires approval and payment to the KGSA. A licensed plumber is required to complete the hook up.

Implementation of measures to address septic problems may require a number of permits and reviews. A permit is required to create a septic system (12VAC5-610-250). Dye testing septic systems will require property owner approval and notification to tenants as necessary. Section 8.11.2.5 of the King George Zoning Ordinance requires that septic tanks be pumped out every five years. Written notification is required to be submitted to the county Zoning Administrator. When a drainfield floods and sewer service is available, VDH can require hook up to the sewer. If public sewer is not available, a flooding drainfield may warrant a new system design due to proximity to the water table. Alternative on-site septic systems require the assistance of a septic system engineer.

Handling and disposal of waste from boats is subject to the VDH Marina Program's marina and boat mooring facility pump-out and dump station requirements[3]. If the boat waste ultimately ends up in the public sewer system, an agreement with KGSA for disposal is required.

5.2.4 Lead Agencies

VDH is the primary agency responsible for these measures. Measures associated with improving the sewer system will be done in conjunction with KGSA. VDH or TCCSWCD may coordinate the program and funding for closing old/unused septic tanks and hooking up remaining septic users to the sewer. Dye testing the septic systems in the trailer park will necessarily include coordination with the trailer park manager and/or owner.

5.3 BMPs to Address Pet Waste

The second category of management measures deals with eliminating bacteria associated with pet waste. The goal can be achieved through a community education campaign on pet waste (discussed in **Section 5.5**), continued maintenance and operation of the ten pet waste stations, and a volunteer or commercial service to regularly pick up pet waste that has not been properly disposed.

Ongoing operation and maintenance of the ten existing pet waste stations will be an essential component of addressing this problem. Additional locations may also be warranted. Guidance on the operation and maintenance of pet waste stations is available from TCCSWCD, ICPRB, and commercial pet waste collection services.

Despite the availability of pet waste stations and enhanced efforts to educate residents and visitors about the importance of proper pet waste disposal, some waste will still not be disposed of in a responsible manner. A pet waste clean-up effort is recommended to address the remaining waste. Pet waste pick-up services may be provided by a paid service or through community volunteer efforts; however, it is important that the beach and other popular pet walking areas are kept free of pet waste.

Fairview Beach pet waste station

[3] https://www.vdh.virginia.gov/EnvironmentalHealth/ONSITE/MARINA/sanitaryfacilities.htm, accessed 6/6/2014.

5.3.1 Anticipated Load Reductions

The pet waste stations will remove the majority (75%) of pet waste from the sub-watersheds (DCR 2013). The remaining 25% of pet waste will be removed through a pick-up effort. In combination, the measures will remove virtually all (99%) of the bacteria from pet waste (**Table 5-3**). Removing the sources of bacteria associated with pet waste in the Fairview Beach sub-watersheds will result in an overall load reduction of 8.41E+12 cfu/year of *Enterococci* in the plan area (**Table 4-19**).

Table 5-3. Bacteria removal efficiency of management measures related to pet waste.

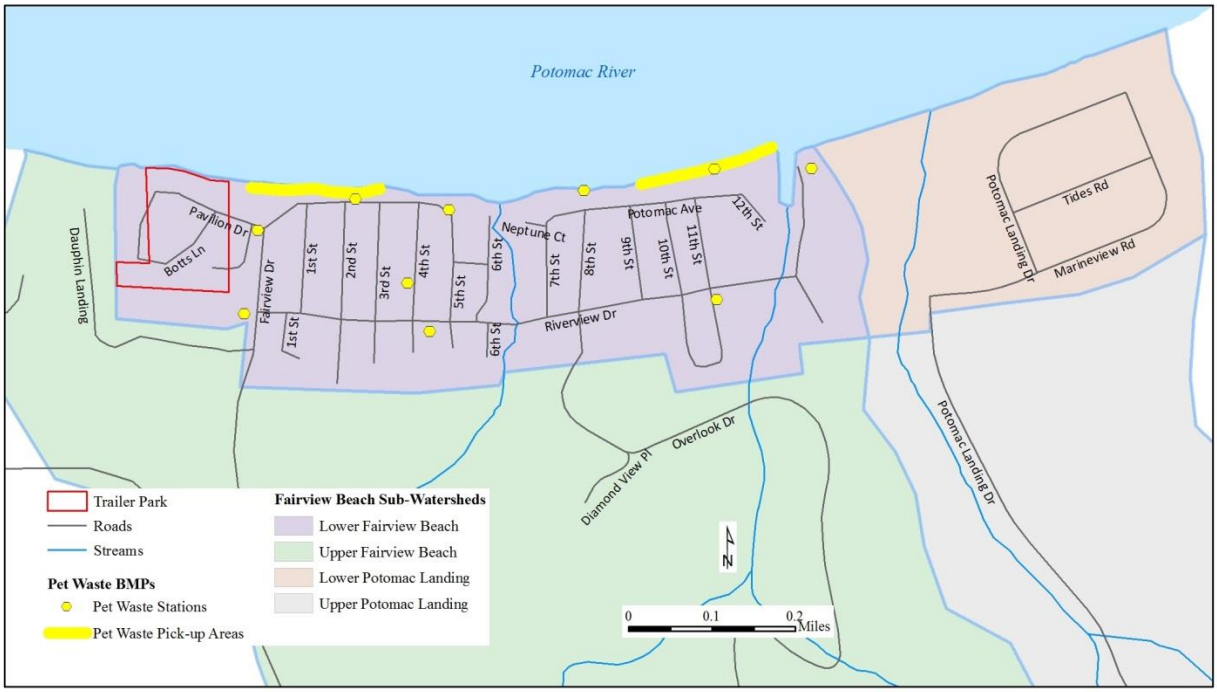
Measure	Units for Tracking	Efficiency %	Reference
Pet waste stations	System	75	Piankatank IP
Pet waste pick-up (volunteer or service)	Program	99	James River IP*

*http://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/ImplementationPlans/jamesricip.pdf, accessed 6/28/2014.

5.3.2 Critical Areas

Ten pet waste stations are currently maintained in the Lower Fairview Beach sub-watershed (**Figure 5-3**). In the future, the Lower Potomac Landing sub-watershed and the trailer park in the Lower Fairview Beach sub-watershed may also benefit from a pet waste station. Additional pet waste pick-up is needed along the beach and other high-use public areas and areas directly draining to the beach.

Figure 5-3. Areas for implementation of BMPs to control bacteria from pet waste.



5.3.3 Necessary Permits and Review

The Fairview Beach bylaws require pet owners to properly remove and dispose of pet waste from the beach. There are no permit or review processes except land owner approval required for implementation of the recommended pet waste management activities.

5.3.4 Lead Agencies

To date, pet waste education and management practices in the plan area have been managed by TCCSWCD and FBRA. It is anticipated that these organizations will continue to lead this effort.

5.4 BMPs to Address Stormwater

The third prong of reducing bacteria to meet the water quality standard at Fairview Beach addresses stormwater. Specifically, the remaining bacteria (non-human, non-pet) transported in stormwater should be reduced by 50%. Proposed stormwater BMPs include installing rain barrels, porous pavement, vegetative buffers, and rain gardens and re-directing downspouts onto grassy areas. Optimizing stormwater management when the trailer park is re-developed and encouraging low intensity development are also recommended.

Rain barrels capture runoff from roofs for beneficial uses such as on-site irrigation. Typical household rain barrels are inexpensive, relatively simple to install, and hold 50 to 100 gallons of water. Assistance on rain barrel installation and maintenance is available through ICPRB.

Porous pavement and other materials such as pervious pavers allow surface runoff to infiltrate traditionally impervious surfaces like roads. Over time, heavy use compacts and fills in the pores, thereby reducing or eliminating the effectiveness. Installation is, therefore, most appropriate for low-intensity use areas such as driveways and parking lots. Even in these locations, however, porous pavement and pervious pavers must be regularly maintained (i.e. quarterly) to ensure effectiveness (COG 1992). Technical assistance on implementation is available through DEQ, the Chesapeake Stormwater Network, and the Virginia BMP Clearinghouse. DEQ Stormwater Design Specification No. 7 also provides detailed information on the use of porous pavement.

Vegetative buffers have numerous benefits including decreasing flows, increasing infiltration, removing pollutants, improving aesthetics, and creating habitat. To be most effective, buffers design should be site specific (Moltz et al. 2004). Improvements to the common area buffer along the river bluff with native shrubs and grasses would help reduce stormwater velocities, thereby reducing some of the erosion of the bank below. The Buffer Manual is available to assist in the implementation of riparian buffers in Virginia (DCR 2006).

Rain gardens are areas of high infiltration that absorb surface runoff during storms. They can also be a beautiful addition of native vegetation to a community. Installation and maintenance of rain gardens ranges from simple to highly sophisticated. DEQ Stormwater Design Specification No. 9[4] provides detailed information on bioretention practices including rain gardens. Existing structures may be re-purposed to enhance infiltration. For example, closed septic areas may be re-designed as bioretention features. Tree boxes may be another effective way of capturing stormwater runoff in the plan area. Tree boxes are small, in-ground bioretention containers installed under trees to collect and treat stormwater.

[4] http://vwrrc.vt.edu/swc/NonPBMPSpecsMarch11/VASWMBMPSpec9BIORETENTION.html, accessed 6/18/2014.

Encouraging low impact development techniques and taking advantage of re-development opportunities to minimize the impacts on local hydrology are also planned because of the significant impervious cover in the Fairview Beach area. DEQ, the Chesapeake Stormwater Network, and the Virginia BMP Clearinghouse are technical resources available for low impact development techniques. George Washington Regional Commission and King George County planners can assist with re-development opportunities in the trailer park area.

5.4.1 Anticipated Load Reductions

The goal of the stormwater management measures is to mitigate 50% of the non-human, non-pet bacteria transported in stormwater in the plan area. Bacteria reduction efficiencies associated with the proposed measures are provided in **Table 5-4**.

Table 5-4. Bacteria removal efficiency of management measures to address stormwater.

Measure	Units for Tracking	Efficiency %	Reference
Rain barrels	Area	90	James River IP*
Redirecting downspouts onto grassy areas	Area	70	Assume similar to rain gardens, James River IP*
Porous pavement	Area	50	Virginia TMDL IP Manual
Vegetative buffers/swales	Area	97†	James River IP*
Rain gardens	Area	70	James River IP*
Re-development opportunities in the trailer park area	Measure dependent	75	Assume implementation of substantial stormwater management measures
Encourage low impact development techniques			
Infiltration systems	Area	83†	EPA 1999
Dry wells	Area	83†	EPA 1999
Bioretention	Area	91†	Hathaway et al. 2009

†average of reported values

*http://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/ImplementationPlans/jamesricip.pdf, accessed 6/28/2014.

To ensure that sufficient load reductions can be expected from the proposed measures, bacteria load reductions were calculated utilizing **Eq. 5-1** (**Table 5-5**). Loading rates, used in **Eq. 5-1**, were calculated for each sub-watershed by multiplying the total load from bird and wildlife sources (**Table 4-19**) by the number of acres in the sub-watershed. Load reductions achieved through the installation of stormwater BMPs may be higher than indicated in **Table 5-5** if the stormwater also contains bacteria from other sources such as pets or humans.

load reduction (cfu/year) = area (acres) * loading rate (cfu/acre/yr) * reduction efficiency (**Eq. 5-1**)

Table 5-5. Load reductions for proposed stormwater BMPs.

	Area (acres)	Loading rate (cfu/acre/yr)	Reduction efficiency	Bacteria load Reduction (cfu/year)
Rain Barrels	*roof area*			
Lower Fairview Beach	6.9	4.26E+10	90%	2.63E+11
Upper Fairview Beach	1.2	1.26E+10	90%	1.40E+10
Lower Potomac Landing	1.8	2.23E+10	90%	3.70E+10
Upper Potomac Landing	0.1	1.20E+10	90%	1.50E+09
Re-directing Downspouts	*roof area*			
Lower Fairview Beach	6.9	4.26E+10	70%	2.05E+11
Upper Fairview Beach	1.2	1.26E+10	70%	1.09E+10
Lower Potomac Landing	1.8	2.23E+10	70%	2.87E+10
Upper Potomac Landing	0.1	1.20E+10	70%	1.17E+09
Porous Pavement	*firehouse parking lot area*			
Lower Fairview Beach	0.2	4.26E+10	50%	4.26E+09
Vegetative Buffers/Swales	*buffer/swale drainage area*			
Lower Fairview Beach	35.0	4.26E+10	97%	1.45E+12
Lower Potomac Landing	22.0	2.23E+10	97%	4.76E+11
Rain Garden	*rain garden drainage area*			
Lower Fairview Beach	8.0	4.26E+10	70%	2.38E+11
Lower Potomac Landing	6.0	2.23E+10	70%	9.37E+10
Re-development Opportunities in the Trailer Park	*trailer park area*			
Lower Fairview Beach	40.0	4.26E+10	75%	1.28E+12
Other Low Impact Development Techniques	*bioretention, dry well, infiltration, etc. drainage area*			
Lower Fairview Beach	31.1	4.26E+10	80%	1.06E+12
Upper Fairview Beach	677.5	1.26E+10	30%	2.56E+12
Lower Potomac Landing	37.3	2.23E+10	80%	6.66E+11
Upper Potomac Landing	225.7	1.20E+10	30%	8.15E+11
Initial Stormwater Load (Birds and Wildlife)				**1.8205E+13**
Total Load Reduction				**9.19E+12**
Percent Reduction in Stormwater Load from Birds and Wildlife				**50%**

A 50% load reduction will be achieved by implementing the proposed measures resulting in a reduction of 9.19E+12 cfu/year of *Enterococci* in the plan area. The reduction will provide additional benefits to existing stormwater BMPs in the plan area (**Table 5-6**).

Table 5-6. Load reductions from existing stormwater BMPs.

	Area (acres)	Loading rate (cfu/acre/yr)	Reduction Efficiency	Bacteria load reduction (cfu/year)
Dry Well				
Lower Fairview Beach	0.34	4.258E+10	83%	1.19E+10
Lower Potomac Landing	1.47	2.232E+10	83%	2.72E+10
Bioretention				
Lower Fairview Beach	0.22	4.258E+10	70%	6.50E+09
Infiltration				
Lower Fairview Beach	4.96	4.258E+10	83%	1.75E+11
Lower Potomac Landing	5.14	2.232E+10	83%	9.52E+10
Planted Trees				
Lower Fairview Beach	0.28	4.258E+10	10%*	1.20E+09
Initial Stormwater Load (Birds and Wildlife)				**1.82E+13**
Total Load Reduction				**3.17E+11**
Percent Reduction in Stormwater Load from Birds and Wildlife				**2%**

*Bacteria reduction efficiency assumed to equal stormwater reduction efficiency utilized by King George County.

5.4.2 Critical Areas

The geographic extent of stormwater management activities necessary to achieve the desired load reductions are described in this section for each of the proposed activities.

Installation of vegetative buffers and swales on private property, community common areas, and along the eroding bluff will also assist in stormwater control. Two acres of buffers are proposed in the Lower Fairview Beach and Lower Potomac Landing sub-watersheds (**Figure 5-4**).

Stormwater associated with all household rooftops (**Figure 5-5**) will need to either have a re-directed downspout or a rain barrel to capture runoff during rain events. It was assumed for planning purposes that half of the households will select rain barrels and half will opt to re-direct the downspout.

Low intensity use areas such as the fire house parking lot (**Figure 5-4**) and residential driveways (**Figure 5-5**) are ideal locations for installing a permeable surface. The 0.2 acre fire station parking lot will serve as a demonstration site for porous pavement or other permeable surfaces like pervious pavers. This site may encourage others to implement these materials on low intensity use areas such as private driveways.

In communication with the planning advisory committees, a demonstration rain garden was proposed for an abandoned KGSA well site. The demonstration site may serve as an example to community members as to the benefits of rain gardens and encourage their implementation throughout the plan area. Stormwater draining from 14 acres of land in the lower sub-watersheds are proposed to be captured in rain gardens. To achieve this goal, approximately 28 rain gardens (100-300 sq. ft. each) will be needed that each drain half of an acre; however, lots in the Lower Fairview Beach sub-watershed are generally smaller than a quarter of an acre. More rain gardens will be needed if residents would prefer to install rain gardens that solely control stormwater from their lot.

The trailer park was re-zoned to accommodate multi-unit dwellings (**Figure 5-4**). The re-development of this area presents an opportunity to implement low impact practices that minimize stormwater runoff. It is assumed that this area will be re-developed with optimal stormwater controls that have at least a 75% bacteria reduction capability.

Other low impact development techniques should be encouraged throughout the remainder of the plan area. One example of this type of activity includes infiltration systems. Infiltration trenches along the roadways (**Figure 5-4**) would reduce the surface runoff and the associated bacteria problem. A number of other low impact development measures such as dry wells and tree plantings have already been implemented due to the county's comprehensive plan requirements (**Figure 5-1**). Continued stormwater management throughout the area will be essential to achieving water quality goals.

Figure 5-4. Areas for implementation of BMPs to control bacteria in stormwater.

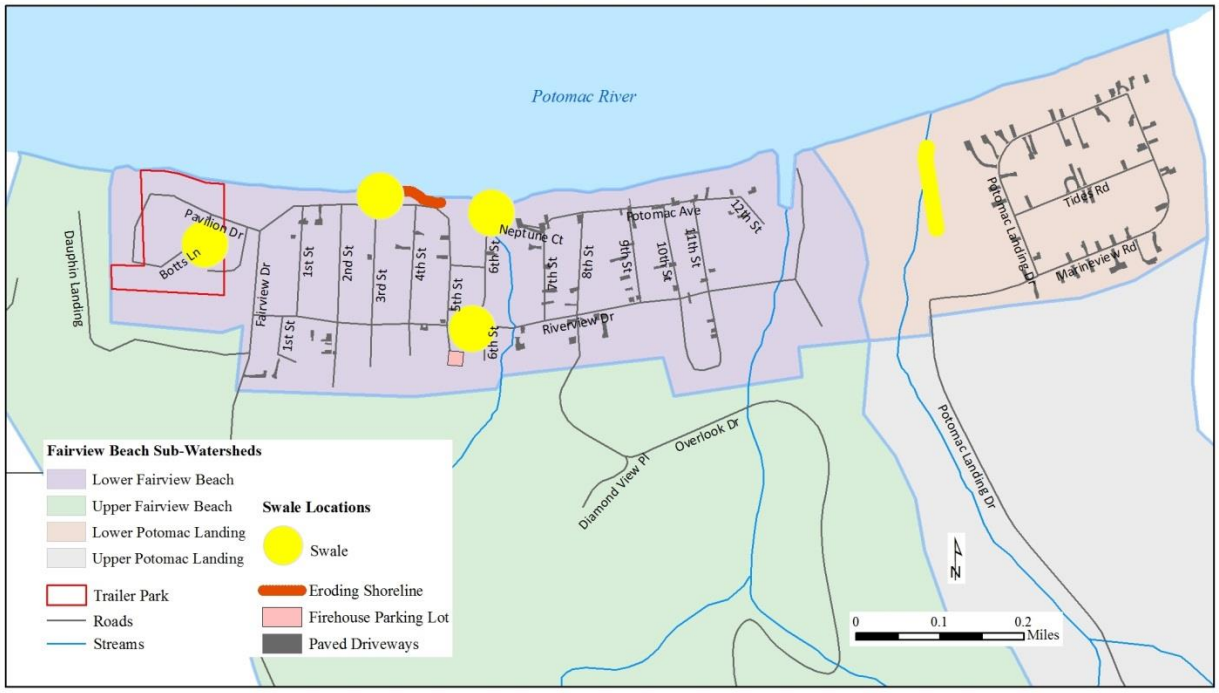


Figure 5-5. Parcels, buildings, and driveways. Parcel polygons are outlined in brown. Buildings are displayed as polygons with black boundaries. Hashed lines represent the driveways. This view was captured on the county's online GIS data viewer, 6/12/2014.

5.4.3 Necessary Permits and Review

The primary review and approval necessary for implementation of the stormwater measures is land owner approval (e.g. rain barrels, re-directing downspouts, vegetative buffers, and rain gardens). In some cases, construction permits may be required. For example, re-development of the trailer park required re-zoning of the property and will require construction permits prior to building the new multi-unit dwellings. Permits may also be required for some low impact development techniques, but determination will be required on a site-by-site basis.

5.4.4 Lead Agencies

TCCSWCD is the lead agency for implementing the rain barrel program, re-directing downspouts onto grassy areas, and installing vegetative buffers and rain gardens. FBRA will lead the effort to identify opportunities for implementation of porous pavement in common areas of the community. Due to its responsibilities through the Virginia Stormwater Management Program, DEQ will work with King George County to encourage low impact development techniques in the community. The county can also promote re-development opportunities in the trailer park.

5.5 Educational Activities

A number of educational activities are proposed because behavioral modifications are more likely if the targeted populations are made aware of the problem and given the skills to address the issue (Hungerford and Volk 1990). The education campaigns, discussed below by source type, will support implementation of the human, pet, and stormwater measures. In addition to source-specific programs, a

general education campaign can be implemented to make citizens and visitors aware of timely issues and promote bacteria reduction activities. Implementation of these activities can build on previously developed education materials. Sources of existing educational materials include VDH, TCCSWCD, and DEQ.

Elimination of bacteria from human sources will require communication with property owners to identify problem areas for both sewer and septic systems. Further, to assist in locating old, unused septic systems, a new requirement to provide records of old septic systems to be submitted to VDH during a property transfer or hook up of the septic system to public sewer. Also, a recreational boater education program, encouraging more inspections of boats by the Coast Guard Auxiliary, and participating in the Virginia Clean Marina Program will assist the community in removing human sources of bacteria from boaters.

Existing pet waste educational programs include a "welcome packet" for new residents. Additional education campaigns to assist in eliminating the pet waste problem include 1) a program to distribute leash bag holders to local and visiting pet owners and 2) a recreational boater education program targeting pet owners so that pet waste is not left on the beach. Focusing some beach signs towards the water is one way to target recreational boaters, and reminding them that using a bag to collect dog feces and disposing of it properly is expected in the Fairview Beach community.

There is a noticeable population of feral cats in the sub-watersheds, according to residents (Fairview Beach Watershed Plan public meeting, 2/20/2014). Although feral cats are not a major contributor to the bacteria problem, control of the population may reduce bacteria numbers to some degree.

Educational sign at Fairview Beach.

5.5.1 Anticipated Load Reductions

Although the educational activities recommended in this plan do not directly reduce the bacteria loads at Fairview Beach, they are essential to successful implementation of the other measures.

5.5.2 Critical Areas

To effectively educate the public, strategic placement of educational materials and activities will be required (**Table 5-7)**.

Table 5-7. Locations for implementation of educational activities to address the bacteria impairment at Fairview Beach.

Measure	Location for Implementation
General education program	Newsletters, websites (e.g. FBRA website), educational brochures, Grandview Estates, store near trailer park, special events, and water taxis operated by Rick's and Tims II
Mailings to trailer park owner to determine where problems exist	Trailer park
New requirement to provide records of old septics during property transfer or hook up of system to sewer	Plan area
Proper septic maintenance education program, including educational materials, technical advice	Areas outside of the sewer service boundary (e.g. store near trailer park), FBRA website

Measure	Location for Implementation
Leash bag holder distributed for pet owners	Areas frequented by community and visitor pet owners
Recreational boater education program	Areas frequented by recreational boaters (e.g. marina, businesses)
Encourage more inspections of boats by the Coast Guard Auxiliary	Plan area
Participate in Virginia Clean Marina Program	Marina
Feral cat population control education program	Plan area

5.5.3 Necessary Permits and Review

Participation in the Virginia Clean Marina Program requires adoption of pollution prevention measures. Becoming a Clean Marina requires that a marina undergo review and inspection through the program. Otherwise, there are no permit or review processes required for implementation of the recommended educational activities except land owner approval.

5.5.4 Lead Agencies

The lead agency associated with each educational measure varies depending on the topic materials and the scope of the program. **Table 5-8** provides the lead agencies for the educational measures.

Table 5-8. Lead agencies associated with the educational activities.

Measure	Lead Agency
General education program	TCCSWCD
Mailings to trailer park owner to determine where problems exist	Mike Shrewsberry - trailer park manager
Proper septic maintenance education program, including educational materials, technical advice	TCCSWCD, VDH
Leash bag holder distributed for pet owners	TCCSWCD
Recreational boater education program	TCCSWCD, VDH
Encourage more inspections of boats by the Coast Guard Auxiliary	Coast Guard Auxiliary
Participate in Virginia Clean Marina Program	Virginia Clean Marina Program (VDH)
New requirement to provide records of old septics during property transfer or hook up of system to sewer	King George County
Feral cat population control education program	TCCSWCD, FBRA

5.6 Other BMPs

Although load reductions necessary to achieve water quality standard are expected to be achieved by controlling human, pet, and stormwater sources, other BMPs will promote additional bacteria reductions and provide a margin of safety. Proposed additional efforts include beach erosion control, wildlife management, and agricultural education.

Beach erosion is an ongoing problem at Fairview Beach. Since 2003, Fairview Beach has suffered significant damage in major storms, including Hurricane Isabel (2003) and Tropical Storm Ernesto (2006), which destroyed the bulkheads protecting the beach (VT 2006). VT staff (2005, 2006, and 2007) asserted without structural improvements the swimming advisories could be expected to continue. They recommended 1) repairing breakwater structures to control beach erosion, 2) improving drainage control so that runoff does not flow into swimming areas, and 3) increasing the width of the

beach by a minimum of ten to fifteen yards. FBRA (http://www.fairviewbeach.org/erosion-repair/, accessed 7/4/2014) is engaged in several projects to improve the physical structure of the beach and reduce beach erosion. Their efforts include 1) repairing the bulkheads and enhancing them with native vegetation to hold them in place; and 2) repairing or replacing groins controlling erosion from the beach. Plans are underway to improve drainage control by repairing culverts and installing drop inlets to prevent erosion from stormwater.

Residents notice birds on the piers near 6th Street, the marina, and on the pier at the local beachfront restaurant, especially during winter (Fairview Beach Watershed Plan CWG meeting, 5/15/2014). A number of measures are available to discourage birds and other wildlife from visiting the beach (Hartmann et al. 2010). Actions include, but are not limited to additional trash cans, regular beach clean-up, educational signs, and bird deterrents on the piers.

Piers near 6th Street.

TCCSWCD and Virginia Cooperate Extension worked to determine the extent of agricultural activities in the plan area. In total, approximately 25 chickens and a handful of goats were identified. There is also some equestrian activity to the west of the plan area. Based on this information, it was determined that specific BMPs for agricultural activities are not necessary at this time; however, outreach should be provided to the agricultural community as necessary.

5.6.1 Anticipated Load Reductions

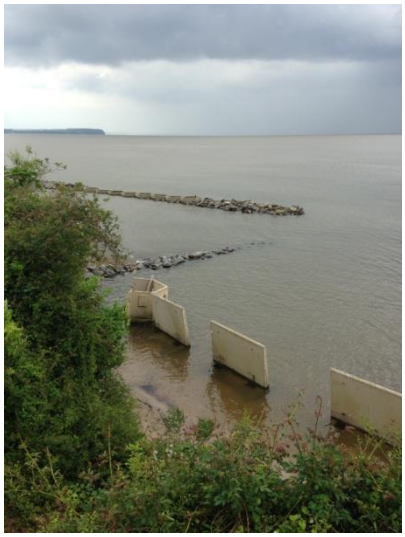
Increasing the width of the beach will increase the length of the transport path through groundwater and enhance its filtering effect (personal communication, C. Hagedorn, 6/12/2014). Erosion control prevents re-suspension of bacteria from the beach sand and prevents new sources of inland bacteria from being introduced into the water. The opportunity may exist to incorporate pollution control structures like sand filters into drainage control design. Erosion control structures can inhibit the dispersal of bacteria attached to sediments (personal communication, R. Gast, 6/16/14; personal communication, M. Nevers, 6/12/14); however, they should not exacerbate the bacteria problem at Fairview Beach if the other measures adopted to control bacteria are effective. Additional studies are needed to quantify anticipated load reductions from beach erosion control. Anticipated load reductions are expected to be highly site-specific.

Decreasing the number of birds at other beaches has reduced the number of swim advisories (e.g. Hartmann et al. 2010). Specific bacteria reductions associated with discouraging birds from visiting Fairview Beach will depend on the approaches utilized, the number of birds no longer contributing to the bacteria problem, and the associated reduction efficiencies. Reducing the number of birds may reduce the bacteria concentrations in beach sand and other potential bacteria reservoirs. This may have a major effect on reducing observed bacteria concentrations, since a large number of birds are present in the off-season.

5.6.2 Critical Areas

Beach management measures are needed from 1st through 6th streets; however, the 4th through 6th street area is most critical. The total length that needs a wall is approximately 1,300 ft. (personal communication, T. Hudson, 6/12/2014).

The primary focus of bird reduction measures in the plan area should be on the piers near 6th Street, the marina, and at the local beachfront restaurant, especially during winter.



Existing beach management measures.

5.6.3 Necessary Permits and Review

The beach management measures require two permitting and review processes. The first is a Joint Permit Application that requires approval by the U.S. Army Corps of Engineers, DEQ, VIMS, King George County Wetlands Board, and Virginia Marine Resources Commission (VMRC). A second permitting process is required through Virginia Department of Transportation (VDOT) for any drainage work conducted along Fairview Drive.

Bird reduction measures are not anticipated to require permits. Installation of bird deterrents (or other bird management measures) on the pier at the local beachfront restaurant and the private piers near 6th Street will require land owner approval and participation.

5.6.4 Lead Agencies

FBRA is taking the lead on repairing bulkheads and enhancing them with vegetation as well as increasing the width of the beach by 10-15 yards, although they welcome assistance with their efforts. Either FBRA or TCCSWCD may take the lead on discouraging birds from visiting the beach.

6 Implementation Schedule

The Fairview Beach Watershed Plan will be implemented in two phases over a ten year period. Phase 1 will be completed in years one through five. Phase 2 will be completed in years six through ten. During Phase 1, all human and pet sources of bacteria should be addressed including septic system repairs in the trailer park. A number of stormwater measures will also be implemented. The trailer park will be converted from septic to sewer in Phase 2. Also, Phase 2 will continue to improve stormwater controls utilizing an adaptive approach until water quality criteria are met. Ongoing monitoring, discussed in **Section 4.2**, will enable adaptive decision-making about the need for Phase 2 implementation.

Human sources of bacteria will be addressed during Phase 1 including fixing the public sewer system, private septic systems, and waste from marine wastewater systems. Re-development of the trailer park under the new multi-unit zoning may not occur for a number of years; therefore, this geographic area will likely not be hooked up to the public sewer system until Phase 2. Septic systems remaining in the plan area, including those in the upper sub-watersheds, will need to be pumped out during Phase 2. Other ongoing activities in Phase 2 will include maintenance of the boat pump-out station at the marina and the boat program to collect waste from other boats during high traffic times.

In terms of reducing bacteria from pet waste, three new pet waste stations will be installed in the Lower Potomac Landing sub-watershed and one new pet waste station will be installed in the trailer park

during Phase 1. The existing ten stations will be maintained in good working order. During Phase 2, the fourteen pet waste stations will be maintained. For the duration of Phase 1 and Phase 2, supplemental pet waste collection activities will be conducted.

The vast majority of the stormwater management measures will be implemented during Phase 1. Two of these, specifically the rain gardens and porous pavement installations, include demonstration efforts to encourage additional installations. Encouraging low impact development techniques will occur during both phases of implementation. Installation of stormwater measures during re-development of the trailer park is a Phase 2 activity.

Phase 1 educational activities include the mailing to the trailer park owner to determine where problems exist, encouraging more inspection of boats by the Coast Guard Auxiliary, participation in the Virginia Clean Marina Program, and adoption of a new requirement to provide records of old septic systems. Long-term education programs will also be necessary to promote ongoing stakeholder awareness. Ongoing education programs include a general education program, proper septic maintenance program, leash bag holder distribution, and the recreational boater education program.

Other management activities to be implemented during Phase 1 include beach erosion control (i.e. repairing and improving the bulkheads and increasing the width of the beach). Discouraging birds from visiting the beach will occur during both phases of implementation.

As mentioned previously, these management measures should be implemented adaptively and in concert with monitoring efforts. Implementation of additional plan components may not be necessary once water quality objectives are reached.

7 Costs, Benefits, and Funding Sources

Prior to implementation, it is necessary to weigh the costs and benefits of proposed measures. Further, identification of potential funding sources will assist in evaluating the feasibility of proposed measures and facilitate their subsequent implementation. To this end, the costs, benefits, and funding sources of implementation are provided in this section.

7.1 Costs and Benefits

The costs of implementing the proposed management measures are listed in **Table 7-1**. Costs were calculated by multiplying the per unit cost of each measure with the number of units. Cost information was obtained from local sources where possible. In cases where local cost information was not readily available, Virginia TMDL Implementation Plans, Virginia TMDL manual (DCR and DEQ 2003), or literature cost estimates were utilized.

The total cost for implementation of this plan is approximately $1,177,327. Phase 1 implementation will cost an estimated $910,684. Phase 2 implementation may cost $266,642. Phased implementation of the plan is discussed in **Chapter 6**. The costs associated with each measure are discussed below.

The cost of improving the sewer system by finding and fixing leaking laterals using dye or smoke testing is broken into two components. Firstly, it costs an estimated $20,000 to conduct the dye/smoke testing (personal communication, KGSA, 5/6/2014). Repairing identified leaks costs an estimated $5,000 for each connection in residential areas. The cost of repairing leaks may be reduced to $3,000 per connection in close communities where the work can be conducted for the entire area simultaneously. These are average costs obtained from four commercial companies in King George County. The cost of

repairing the leaks is not included in total plan implementation cost because it is not yet known how many connections need repairs.

The EPA cites the estimated cost of dye testing to be $290 per residence[5]. Given the close proximity of trailers in the trailer park and the interconnectedness of the system to a common drainfield, it was assumed that the full cost would not be required for each trailer. Instead, a total cost of $1,200 is estimated for the trailer park.

The capital cost of the boat pump-out station at the marina has already been covered. Maintenance costs are ongoing and will depend on the nature of repairs needed.

A boat that collects waste from other boats during high traffic times costs approximately $3,000 per year, totaling $15,000 per phase of implementation (personal communication, Redfish Island Marine, 6/18/2014). This cost assumes five weekends of operation per year and includes labor, gas, insurance, personnel, and maintenance. The cost of the boat is not included. It is anticipated that this program will be conducted through VDH. Funding is available through the Clean Vessel Act Grant Program to cover the cost of this program.

The cost of pumping and closing old/unused septic tanks is estimated at $300 per system (DCR 2013). An estimated 262 households in the Lower Fairview Beach sub-watershed are candidates for having old/unused septic systems based on the sewer service boundary location. When connecting to the public sewer system, many of the houses in the Lower Fairview Beach sub-watershed likely closed their systems. Therefore, it was assumed that one quarter of the residences (66 in total) may still have old/unused systems that need to be addressed. Since the Lower Potomac Landing sub-watershed was constructed with access to the public sewer system, the area does not have old/unused tanks. The upper sub-watersheds' septic systems are still active.

The septic systems in the trailer park will be repaired during Phase 1 of the implementation process. At an estimated $3,000 each, the cost of repairing these systems is $120,000. In some cases, failing septic systems may need to be replaced with alternative on-site septic systems. These systems cost an estimated $25,000 to install and maintain (DCR 2013). The costs of these systems is not included in the total cost of implementation because it is not known how many alternative systems will be necessary. In addition, all active septic systems in the plan area require pumping every five years, costing $300 each (DCR 2013).

Connecting septic users within the KGSA service area to the public sewer system during Phase 1 and septic users within the trailer park during Phase 2 costs approximately $5,600 for each connection (DCR 2013). In addition to the capital cost and the cost of required technical assistance, KGSA requires a connection fee of $11,000 per household. There has been discussion of waiving the $11,000 connection fee to implement the watershed plan. The waiver was assumed to be approved in the estimated implementation cost. If the connection fee is not waived, the cost of implementation will be much larger than currently estimated.

Flooding drainfields will be addressed by pumping, closing, and/or repairing septic systems in the plan area. Therefore, the cost of implementing this measure is included in the cost of the other measures. There is no explicit cost with this measure unless installation of a novel residential wastewater system design is chosen by the homeowner as the means for addressing the flooding drainfields.

The cost associated with addressing the bacteria contribution from pet waste utilizing pet waste stations and supplementary pet waste pick-up is $4,800 based on cost estimates from DCR (2013).

[5] http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=25, accessed 7/4/2014.

Additional expenses will be incurred if pet waste pick-up is conducted by a commercial service rather than a community-based volunteer effort. The budget assumes the use of volunteers for this purpose.

Rain barrels are roughly $90 each; therefore, the cost of installing 198 of them is $17,820. Similarly, re-directing downspouts costs an estimated $100 each (DEQ 2013), making the cost of implementing that management measure $19,800.

Porous pavement is a relatively expensive management practice at $8.50 per sq. ft. Bi-annual maintenance of porous pavement is critical and costs approximately $0.04 per sq. ft. (personal communication, C. French, Filterra Bioretention Systems, 6/30/2014). Due to the expense, conversion of private driveways to porous pavement is a proposed Phase 2 activity that may be voluntarily implemented as necessary to achieve water quality goals. Pervious pavers can be more expensive and cost up to $10 per sq. ft. according to several online cost estimates including the University of Maryland Extension.

The costs of the multiple educational programs were estimated utilizing values from DCR (2013). Several of the other Fairview Beach educational measures are not expected to cost anything. These measures include encouraging more inspections of boats by the Coast Guard Auxiliary, participating in the Virginia Clean Marina Program (system upgrades would have associated costs), and adopting a new requirement to provide records of old septic systems.

The beach management measures will cost approximately $540,000. Of this, $400,000 is required to construct the walls and repair the bulkheads. Approximately $140,000 is necessary to reduce erosion from stormwater runoff. This is an estimate and does not include the cost of any back fill or other efforts to support the bulkhead work (personal communication, T. Hudson, 6/13/2014).

In order to discourage birds from visiting the beach, $1,000 is budgeted per phase of plan implementation. The actual cost of implementation will depend on the specific activities utilized to discourage the birds.

Note that the total cost estimate above DOES NOT include costs associated with implementation of stormwater management activities during redevelopment of the trailer park or the more extensive stormwater management activities that may be necessary during Phase 2 of implementation. Redevelopment costs are not included as they will be covered by the developer. The estimate also DOES NOT include the cost of encouraging low impact development techniques. These practices should be implemented on a site-specific basis as opportunities arise. To provide some indication of the magnitude of these costs, cost estimates for porous pavement and infiltration trenches were developed.

There are 77,793 sq. ft. of driveways in Lower Fairview Beach and 95,390 sq. ft. of driveways in Lower Potomac Landing. At $8.50 per sq. ft. to install (personal communication, C. French, Filterra Bioretention Systems, 6/30/2014), the cost of porous pavement on all driveways would be $661,241 and $810,815 in the Lower Fairview Beach and Lower Potomac Landing sub-watersheds, respectively. Bi-annual maintenance of porous pavement costs approximately $0.04 per sq. ft. (personal communication, C. French, Filterra Bioretention Systems, 6/30/2014).

The average cost of installing infiltration trenches is $28 per sq. ft. (Taylor 2005). With 21,229 ft. of roadways in Lower Fairview Beach and 5,161 ft. of roadways in Lower Potomac Landing, the cost of installing infiltration trenches is $595,295 and $144,723. Maintenance cost is approximately 20% of the construction cost each year, $148,004 for the combined lower sub-watersheds (Taylor 2005). Based on these estimates, the total cost for installing porous pavement on all driveways in the lower sub-watersheds and constructing infiltration trenches along all roadways is $2,038,891. These measures are relatively expensive compared to others listed in **Table 7-1**. Monitoring data collected during

implementation can be used to determine if these additional expenditures are necessary to achieve water quality goals.

Table 7-1. Costs of management measures. Phased implementation is discussed in **Chapter 6**.

Type	Measure	Units	Units Phase 1	Units Phase 2	Cost Phase 1	Cost Phase 2	Total Cost	Cost/Unit
Human	Improve sewer system by finding and fixing leaking laterals using dye/smoke testing	Sewer system	1	--	$20,000 (identify problems)	--	$20,000 + ($5,000 each to fix residential connections)	$20,000
	Dye test septic systems in the trailer park to determine which ones are failing	Trailer park	1	--	$1,200	--	$1,200	$1,200
	Ensure that boat pump-out station at marina is maintained in working order	Pump-out station	ongoing	ongoing	--	--	--	--
	Boat that collects waste from other boats during high traffic times	1 boat for 5 years	1	1	$15,000	$15,000	$30,000	$15,000
	Pump and close old/unused septic tanks (RB-2, only in connection with concurrent sewer connection)	Septic tank	66	--	$19,800	--	$19,800	$300
	Hook up remaining septic users to sewer (RB-2)	Septic system	2 (inside KGSA bndy)	40 (trailer park)	$11,200	$224,000	$235,200	$5,600
	Address flooding drainfields	Septic system	--	--	--	--	--	$5,600
	Repair workable septics (RB-3)	Septic system	40 (trailer park)	--	$120,000	--	$120,000	$3,000
	Septic tank pump-out (RB-1)	Septic tank	80	40	$24,000	$12,000	$36,000	$300
Pet	Pet waste stations	Station	4 new, 10 maintenance only	14 (maintenance only)	$3,400	$1,400	$4,800 (including technical assistance)	$600
	Pet waste pick-up (volunteer)	Program	ongoing	ongoing	--	--	--	--
Stormwater	Rain barrels	Barrel	198	--	$17,820	--	$17,820	$90
	Redirecting downspouts onto grassy areas	Downspout	198	--	$19,800	--	$19,800	$100

Type	Measure	Units	Units Phase 1	Units Phase 2	Cost Phase 1	Cost Phase 2	Total Cost	Cost/Unit
	Porous pavement	Sq. ft.	8,712 (fire station)	--	$75,794	$1,742	$77,537	$8.5 + maintenance
	Vegetative buffers or turf to trees	Acres	2	--	$720	--	$720	$360
	Rain gardens	Sq. ft.	8,400	--	$29,400	--	$29,400	$4
Education	Mailings to trailer park owner to determine where problems exist	Program	1	--	$50	--	$50	$50
	General education program, including feral cat population control program	Program	1	1	$5,000	$5,000	$10,000	$5,000
	Proper septic maintenance education program, including educational materials, technical advice	Program	1	1	$2,500	$2,500	$5,000	$2,500
	Leash bag holder distributed for pet owners	Program	1	1	$1,000	$1,000	$2,000	$1,000
	Recreational boater education program	Program	1	1	$3,000	$3,000	$6,000	$3,000
	Encourage more inspections of boats by the Coast Guard Auxiliary	System	1	--	--	--	--	--
	Participate in Virginia Clean Marina Program	Program	1	--	--	--	--	--
	New requirement to provide records of old septics during property transfer or hook up of system to sewer	Program	1	--	--	--	--	--
Other	Repair bulkheads and enhance with vegetation; Increase width of beach by 10-15 yards	System	1	--	$540,000	--	$540,000	$540,000
	Discourage birds from visiting the beach	Program	1	1	$1,000	$1,000	$2,000	$1,000

The primary Fairview Beach Watershed Plan objective is for Fairview Beach to meet water quality standard for bacteria. Resolving the bacteria impairment at Fairview Beach, however, will improve more than the water quality. Numerous other benefits include improved ecosystem health, cleaner drinking water, enhanced recreational and tourism opportunities, improved economy, and associated aesthetics.

All of the measures implemented at Fairview Beach will have the added benefit of protecting the Chesapeake Bay and making progress towards meeting the Chesapeake Bay TMDL. Further, having functioning public sewer and private septic systems in the community will improve property values. Proper septic tank maintenance extends the life of the system, saving the homeowner money. Rain gardens can decrease water bills by reducing the amount of potable water used for irrigation. The local economy benefits from its proximity to the Potomac River, as Fairview Beach is often considered to be a vacation community. Events on the Potomac River near Fairview Beach such as Aquapalooza and the fireworks at a local waterfront restaurant draw visitors to the area and also contribute to the local economy. Reducing the number of swim advisories may encourage tourism and increase participation in local events.

7.2 Potential Funding Sources

Potential funding sources available during implementation were identified during watershed plan development. A brief description of the programs and their requirements as well as BMP-specific funding opportunities is provided in this chapter. Detailed descriptions can be obtained from the TCCSWCD, DCR, DEQ, VCE, and others listed below. It is recommended that participants discuss funding options with experienced personnel at these agencies to choose the best option.

7.2.1 Virginia WQIF

The WQIF is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient and sediment loads to surface waters. Eligible recipients include local governments, soil and water conservation districts (SWCDs), and non-profit organizations. Grants for nonpoint sources are administered through DEQ. Most WQIF recipients provide matching funds on a 50/50 cost-share basis. Requests for proposals cover nonpoint source reduction projects.

7.2.2 Federal CWA Section 319 Incremental Funds

The EPA develops guidelines and criteria to be used to award CWA Section 319 nonpoint source grants to states. States may use up to 20% of the Section 319 incremental funds to develop nonpoint source TMDLs as well as develop watershed based plans for Section 303(d) listed waters. The balance of funding can be used to implement watershed based plans. Funds can be used for residential and agricultural BMPs, and for technical and program staff to administer the BMP programs.

7.2.3 Virginia Small Business Environmental Assistance Fund Loan Program

The Fund, administered through DEQ, is used to make loans or to guarantee loans to small businesses for the purchase and installation of environmental pollution control equipment, equipment to implement voluntary pollution prevention measures, or equipment and structures to implement agricultural BMPs. The equipment must be needed by the small business to comply with the federal Clean Air Act, or it will allow the small business to implement voluntary pollution prevention measures.

The loans are available in amounts up to $50,000 and will carry an interest rate of 3%, with favorable repayment terms based on the borrower's ability to repay and the useful life of the equipment being purchased or the life of the BMP being implemented. There is a $30 non-refundable application processing fee. The Fund will not be used to make loans to small businesses for the purchase and installation of equipment needed to comply with an enforcement action. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act.

7.2.4 Community Development Block Grant Program

The Department of Housing and Urban Development sponsors this program, intended to develop viable communities by providing decent housing and a suitable living environment and by expanding economic opportunities primarily for persons of low and moderate income. Recipients may initiate activities directed toward neighborhood revitalization, economic development, and provision of improved community facilities and services. Specific activities may include public services, acquisition of real property, relocation and demolition, rehabilitation of structures, and provision of public facilities and improvements, such as new or improved water and sewer facilities.

7.2.5 NFWF

Offers are accepted throughout the year and are processed during fixed signup periods. The signup periods are on a year-round, revolving basis, and there are two decision cycles per year. Each cycle consists of a pre-proposal evaluation, a full proposal evaluation, and a Board of Directors' decision. An approved pre-proposal is a pre-requisite to the submittal of the full proposal. Grants generally range between $10,000 and $150,000. Projects are funded in the U.S. and any international areas that host migratory wildlife from the U.S. Grants are awarded for the purpose of conserving fish, wildlife, plants, and their habitats. Special grant programs are listed and described on the National Fish and Wildlife Foundation (NFWF) website (http://www.nfwf.org, accessed 7/4/2014). If the project does not fall into the criteria of any special grant programs, the proposal may be submitted as a general grant if it falls under the following guidelines: 1) it promotes fish, wildlife, and habitat, 2) it involves other conservation and community interests, 3) it leverages available funding, and 4) project outcomes are evaluated. The NFWF Chesapeake Bay Stewardship Fund may be available for projects that improve urban stormwater management by storing, treating and infiltrating stormwater runoff through management practices such as bioretention and rain water harvesting (http://www.nfwf.org/chesapeake/Pages/2014-chesapeake-rfp.aspx, accessed 7/21/2014). These practices may help in the reduction of beach erosion at Fairview Beach by lessening the quantity of water reaching the beach area from upland sources.

7.2.6 Community Foundation of the Rappahannock River Region

The Foundation will normally make grants from discretionary funds to support new or specific ongoing projects or programs in the areas of cultural, scientific, medical, environmental, social welfare, and educational endeavors within King George County. However, grants will not normally be made to individuals, endowments, or tax-supported institutions. The Board of Directors may grant exceptions on a case-by-case basis. Grants are made to eligible non-profit organizations that are exempt from federal taxation under 501(c)(3) of the Internal Revenue Code. Generally, grants will range from $1,000 to $5,000. Grants will be made for operating expenses of a project including equipment, and will not be made for physical plant, day-to-day operating needs of the organization, or programs involving religious

instruction/activity. The Foundation will strongly consider challenge or matching grants that encourage financial support from individuals and/or other charitable organizations in the project or program.

7.2.7 VDOF

Through the U.S. Forest Service Watershed Forestry Program, the Virginia Department of Forestry (VDOF) has developed a Virginia Trees for Clean Water program designed to improve water quality in the Chesapeake Bay by planting buffers and trees in neighborhoods and communities. A request for proposal was issued during 2013 and 2014 and is expected to be available on a yearly basis. An application form and full instructions can be found on the VDOF website (http://dof.virginia.gov/business/bids.htm, accessed 7/3/2014).

7.2.8 SERCAP

Southeast Rural Community Assistance Project, Inc. (SERCAP) helps small rural towns and communities needing aid in upgrading their water and wastewater systems. They provide training and technical assistance to rural residents for operation and maintenance of those systems, for capacity building and for economic development in their communities. Funding is made available to low-income individuals and communities in the form of grants and loans in order to rehabilitate housing, build water and wastewater infrastructure, assist in small business development, and to finance development projects of small rural governments. SERCAP utilizes volunteers in a variety of programs to conduct these projects, to train community leaders, and to train and recruit additional local volunteers (www.sercap.org, accessed 7/3/2014).

7.2.9 VCAP

VCAP (Virginia Conservation Assistance Program) is a new program administered by participating Soil and Water Conservation Districts that provides financial assistance to property owners installing specific conservation landscaping and stormwater practices. All non-agricultural property owners in participating areas are eligible to apply – residential, business, public and private. Funding is available for installation of cisterns 250 gallons or larger, rain gardens and the conversion of managed turf grass areas into native plants. Other residential stormwater BMPs are currently being considered for the program. Although VCAP is not currently available in King George, there is a strong possibility it will be at some point during the implementation phase of this plan.

7.2.10 U.S. Army Corps of Engineers Section 14 and 103 Assistance

The beach erosion needs at Fairview Beach may be eligible for programs administered by the U.S. Army Corps of Engineers, depending on eligibility requirements and current program funding. Section 14, Flood Control Act of 1946 - Streambank and Shoreline Erosion Protection of Public Works and Non-Profit Public Services - is designed to implement projects to protect public facilities and facilities owned by non-profit organizations that are used to provide public services that are open to all on equal terms. These facilities must have been properly maintained but be in imminent threat of damage or failure by natural erosion processes on stream banks and shorelines, and are essential and important enough to merit federal participation in their protection. Section 103, River and Harbor Act of 1962 - Beach Erosion and Hurricane and Storm Damage Reduction - may be used for protecting multiple public and private properties and facilities and single non-federal public properties and facilities against damages caused by storm driven waves and currents. All projects must be formulated for hurricane and storm

damage reduction, in accordance with current policies and procedures governing projects of the same type which are specifically authorized by Congress (see Section IV of Appendix E of this regulation). Any policies and procedures applicable to federal participation in projects involving beach nourishment must apply to Section 103 projects involving beach nourishment.

7.2.11 BMP-Specific Funding Sources

Funding sources for each management measure were identified in coordination with the local stakeholder committees (**Table 7-2**). It should be noted that traditional EPA CWA 319 funding sources may not be available to cover the cost of improving the sewer system.

Table 7-2. Potential BMP funding sources.

Type	Measure	Potential Funding Sources
	Improve sewer system by finding and fixing leaking laterals using dye/smoke testing	King George County (possibly) and cost share
	Dye test septic systems in the trailer park to determine which ones are failing	TBD
	Ensure that boat pump-out station at marina is maintained in working order	Cost share through VDH clean marina program for repairs, when necessary
	Boat that collects waste from other boats during high traffic times	Clean Vessel Act Grant Program
	Pump and close old/unused septic tanks (RB-2, only in connection with concurrent sewer connection)	319
	Hook up remaining septic users to sewer (RB-2)	319
	Address flooding drainfields	319
	Repair workable septics (RB-3)	319
	Septic tank pump-out (RB-1)	319
Human	Alternative on-site septic system (RB-5)	319
	Pet waste stations	TCCSWCD, FBRA and 319
Pet	Pet waste pick-up (volunteer or service)	TCCSWCD, FBRA
	Rain barrels	NFWF
	Redirecting downspouts onto grassy areas	NFWF
	Porous pavement	NFWF, VCAP
	Encourage low impact development techniques	NFWF
	Re-development opportunities in the trailer park area	Trailer park owner and potential developer
	Vegetative buffers or turf to trees	319, NFWF, VA DOF Urban Tree grant
Stormwater	Rain gardens	319, NFWF, VCAP
	General education program	319
	Mailings to trailer park owner to determine where problems exist	King George County
	Proper septic maintenance education program, including educational materials, technical advice	319
	Leash bag holder distributed for pet owners	319
	Recreational boater education program	319
Education programs	Encourage more inspections of boats by the Coast Guard Auxiliary	N/A

Type	Measure	Potential Funding Sources
	Participate in Virginia Clean Marina Program	No cost for program participation per se - marina improvements cost share through marina program
	New requirement to provide records of old septics during property transfer or hook up of system to sewer	King George County
	Feral cat population control education program	Potential partnership with SPCA to spay/neuter cats
Other	Repair bulkheads and enhance with vegetation	U.S. Army Corps of Engineers
	Increase width of beach by 10-15 yards	U.S. Army Corps of Engineers
	Discourage birds from visiting the beach	U.S. Army Corps of Engineers

8 Milestones

The purpose of this chapter is to identify interim, measurable milestones to determine whether management practices are being implemented as planned. Short-, mid-, and long-range interim project milestones are described. Short-term milestones are activities that will be accomplished within two years of adopting this plan. Within three to five years, the mid-term milestones will be achieved. The long term, six to ten year, milestones are the final activities needed to fully implement the plan. Milestones are presented in a check-list format to encourage regular evaluation. An asterisk at the beginning of the milestone indicates that once initiated, the activity will continue for the duration of plan implementation.

If milestones are achieved in a shorter than expected time frame, implementation efforts should proceed to the next set of activities until the bacteria water quality standard is met. For example, if VDH is able to identify old/unused septic tanks in the plan area within the first year of plan implementation, pumping and closing those septic tanks should be initiated during the first two years of implementation, if possible, rather than waiting until year three. Similarly, if the trailer park is redeveloped sooner than expected or if an agreement can be made with the property owner to hook up the trailers to the public sewer, that area may be hooked up to the public sewer during Phase 1 of implementation.

Alternatively, some project milestones may not be met within the indicated time frame. In that case, the approach should be revised as necessary to ensure that the water quality standard is met in a reasonable amount of time. Some measures, like those related to eliminating the human sources of bacteria in the plan area, will be essential to meeting the water quality standard. The water quality standard will likely not be achieved until human sources are removed. If those sources are not eliminated, the approach for meeting the water quality standard at Fairview Beach needs to be re-evaluated.

8.1 Phase 1 - Short-term (1-2 years) Milestones

- ☐ TSSWCD, FBRA, VDH, and DEQ obtain 319 and NFWF funding for implementation of relevant management measures.
- ☐ VDH contacts trailer park owner to determine where problems exist.
- ☐ KGSA and VDH test the sewer and trailer park septic systems, respectively, to identify potential bacteria sources.
- ☐ VDH identifies old/unused septic tanks in the plan area.
- ☐ * King George County works with local land owners to pump active septic tanks every five years.
- ☐ * VDH ensures that the boat pump-out station at the marina is maintained in working order.
- ☐ * VDH conducts a boat program to collect waste from other boats during high traffic times.

- ☐ * FBRA, with assistance from TCCSWCD, maintains the pet waste stations.
- ☐ * FBRA coordinates a weekly commercial or volunteer-based pet waste pick-up program to remove waste that has not been disposed of in a responsible manner from the beach and other popular dog-walking areas.
- ☐ TCCSWCD works with local residents to ensure that all households in the plan area either install a rain barrel or redirect the downspouts onto grassy areas.
- ☐ * TCCSWCD educates about septic systems, feral cat population control, recreational boater education, pet waste, and general water education.
- ☐ TCCSWCD coordinates with FBRA to distribute leash bag holders to local and visiting pet owners.
- ☐ * The Coast Guard Auxiliary conducts additional inspections of boats in the Fairview Beach plan area.
- ☐ VDH adopts a new requirement to submit records of old septic systems during a property transfer or hook up to the public sewer system.
- ☐ Either FBRA or TSSCWD install measures to discourage birds from visiting the beach (bird deterrents on piers, etc.).

8.2 Phase 1 - Mid-term (3-5 years) Milestones

- ☐ KGSA and property owners work together to fix problems with the sewer system's main lines and household lines, respectively.
- ☐ VDH works with local land owners to fix failing septic systems or install alternative on-site septic systems in the trailer park and throughout the plan area.
- ☐ VDH and/or TCCSWCD pump and close old/unused septic tanks.
- ☐ VDH, TCCSWCD, and KGSA identify and hook up properties with septic systems in the KGSA service area to the public sewer.
- ☐ TCCSWCD installs, with collaboration from FBRA, four additional pet waste stations.
- ☐ King George County re-paves the fire station parking lot with porous pavement or pervious pavers.
- ☐ TCCSWCD installs five vegetative buffers, totaling two acres in the lower sub-watersheds.
- ☐ * King George County and TCCSWCD maintain the porous pavement parking lot on a quarterly basis and the vegetative buffers on an annual basis, respectively.
- ☐ KGSA, with technical assistance from TCCSWCD, installs a demonstration rain garden at the abandoned KGSA well site.
- ☐ * TCCSWCD promotes the demonstration rain garden and porous pavement sites to encourage implementation at other sites throughout the plan area (a total of 8,400 sq. ft. of rain gardens, including the demonstration site and private installations, in the lower sub-watersheds).
- ☐ Virginia Clean Marina Program designates the Fairview Beach marina as a Clean Marina.
- ☐ Property owners implement beach erosion control measures (repair bulkheads, enhance with vegetation, install wall, adjust groins).
- ☐ DEQ evaluates progress towards meeting the water quality standard (see discussion in **Chapter 10**).

8.3 Phase 2 - Long-term (6-10 years) Milestones

- ☐ When the trailer park is redeveloped, the developer installs stormwater management measures that reduce stormwater bacteria loads from the area by 75%. The developer also hooks up the property to the KGSA sewer system. The existing septic systems in the trailer park are properly pumped and closed.
- ☐ Utilizing the results of monitoring data (**Chapter 11**), verify the need for additional stormwater controls. If a need exists, VDOT and the local community install infiltration trenches along roadways and/or other stormwater measures as appropriate.
- ☐ The beach is 10-15 yards wider due to the installation of beach erosion control measures.
- ☐ DEQ evaluates progress towards meeting the water quality standard (see discussion in **Chapter 10**). Ultimately, Fairview Beach achieves the water quality standard for bacteria.

The SC, with assistance from DEQ, is responsible for oversight of the plan's implementation. For each management measure, however, the designated lead agency (**Sections 5.2.4, 5.3.4, 5.4.4, 5.5.4, and 5.6.4**) is responsible for recording information needed to gauge implementation progress. Metrics for measuring BMP implementation progress are provided in **Table 8-1**. In some cases, mapping the locations of BMPs is encouraged.

Table 8-1. Metrics for measuring BMP implementation progress.

Type	Measure	Metric
	Improve sewer system by finding and fixing leaking laterals using dye/smoke testing	Number and magnitude of 1) identified problems and 2) resolved problems
	Dye test septic systems in the trailer park to determine which ones are failing	Number of failing systems identified
	Ensure that boat pump-out station at marina is maintained in working order	Amount of waste collected at the pump-out station
	Boat that collects waste from other boats during high traffic times	Amount of waste
	Pump and close old/unused septic tanks (RB-2, only in connection with concurrent sewer connection)	Number of systems pumped/closed each year
	Hook up remaining septic users to sewer (RB-2)	Number of new sewer connections
	Address flooding drainfields	Number of drainfields fixed
	Repair workable septics (RB-3)	Number of systems repaired
	Septic tank pump-out (RB-1)	Number of tanks pumped
Human	Alternative on-site septic system (RB-5)	Number of systems installed
	Pet waste stations	Amount of waste collected
Pet	Pet waste pick-up (volunteer or service)	Amount of waste collected
	Rain barrels	Number and size of barrels installed
	Redirecting downspouts onto grassy areas	Number redirected
	Porous pavement	Location and area installed
	Encourage low impact development techniques	Number, type, and location of stormwater practices installed
	Redevelopment opportunities in the trailer park area	Number, type, and location of stormwater practices installed
	Vegetative buffers or turf to trees	Location and area installed
Stormwater	Rain gardens	Location and area installed
Education	General education program	Estimated number of people reached

Type	Measure	Metric
	Mailings to trailer park owner to determine where problems exist	Contact made
	Proper septic maintenance education program, including educational materials, technical advice	Estimated number of people reached
	Leash bag holder distributed for pet owners	Number distributed
	Recreational boater education program	Estimated number of people reached
	Encourage more inspections of boats by the Coast Guard Auxiliary	Number inspected
	Participate in Virginia Clean Marina Program	Certification of marina
	New requirement to provide records of old septics during property transfer or hook up of system to sewer	Adoption of requirement
	Feral cat population control education program	Estimated number of people reached
	Repair bulkheads and enhance with vegetation	Number of bulkheads repaired and amount of vegetation added
	Increase width of beach by 10-15 yards	Length of wall installed, number of groins adjusted
Other	Discourage birds from visiting the beach	Types and amounts of bird deterrents utilized

9 Integration with Other Watershed Plans and Projects

Virginia watershed's come under a variety of individual, though related, water quality programs and activities, many of which have specific geographical boundaries and goals. These include, but are not limited to, the Chesapeake Bay 2014 agreement, the Chesapeake Bay TMDL and Watershed Implementation Plan, TMDLs, roundtables, water quality management plans, watershed management plans, erosion and sediment control regulations, Stormwater Management Program, Source Water Assessment Program, green infrastructure plans, and local comprehensive plans.

King George County's Comprehensive Plan, adopted April 16, 2013, addresses the importance of protecting water supplies and surface waters and assuring adequate water quality and quantity to protect their rural character, recreation and healthy economic growth. A number of initiatives to promote this include: promoting alternative methods of stormwater treatment, addressing shoreline erosion issues, encouraging vegetative enhancement of Resource Protection Areas, enforcing the CBPA to reduce impacts of development, and improving water access and recreational opportunities.

Current on-going watershed projects or programs to be integrated into the Fairview Beach Watershed Plan include:

- King George County Comprehensive Plan
- King George County Septic Tank Pump-Out and Inspection Regulatory Program
- King George County Chesapeake Bay Preservation Ordinance
- King George County Stormwater Management Program
- VDH Division of On-Site Disposal Systems, Beach Monitoring Program
- VDH On-Site Sewage Waiver Cost-Share Program (2012 NFWF funding)
- VIMS Center for Coastal Resources Management Shoreline Situation Reports for King George County
- TCCSWCD Pet Waste Education Program
- Fairview Beach Erosion Project

- King George County and George Washington Regional Commission Community Fracking Education and Ordinance Evaluation Initiative
- Naval Support Facility Dahlgren Joint Land Use Study
- Federal Emergency Management Agency Proposed Flood Hazard Determinations for King George County

10 Criteria for Determining Progress towards the Water Quality Standard

Progress towards attaining the bacteria water quality standard at Fairview Beach will be assessed utilizing environmental and programmatic indicators. If interim environmental targets are not met, the approach for implementation of management measures should be re-evaluated. Specifically, a more aggressive approach to stormwater management should be considered during Phase 2.

10.1 Environmental Targets

Interim reductions in bacteria counts are expected after implementation of management measures. Of the 73% reduction in bacteria necessary to meet the water quality standard, a 57% reduction is associated with addressing pet, human, and stormwater sources during Phase 1 (23%, 27%, and 7% respectively). Other measures like beach control and bird deterrents during Phase 1 will further reduce the bacteria loads. Monitoring data (described in **Chapter 11**) will be re-assessed upon completion of Phase 1 to evaluate whether the expected progress was achieved. Results of the evaluation will inform the scope of Phase 2 activities. Adapted Phase 2 activities will accomplish the remainder of the necessary load reductions. Re-evaluation of monitoring data will occur upon completion of Phase 2.

As bacteria loads are reduced, the number and duration of swimming advisories will decrease. Swimming advisories are issued by VDH when the arithmetic average of the bacteria concentrations at the three Fairview Beach monitoring locations exceed 104 cfu/100ml *Enterococci*.

The ultimate purpose of the plan is for Fairview Beach to meet the bacteria water quality standard. Virginia's *Enterococci* water quality standard is described in **Section 4.1**. Ongoing evaluation of monitoring data will be essential in determining when this goal has been achieved. Critical times for re-evaluation of monitoring data are the ends of Phases 1 and 2; however, more frequent reviews will be considered as necessary.

10.2 Programmatic Targets

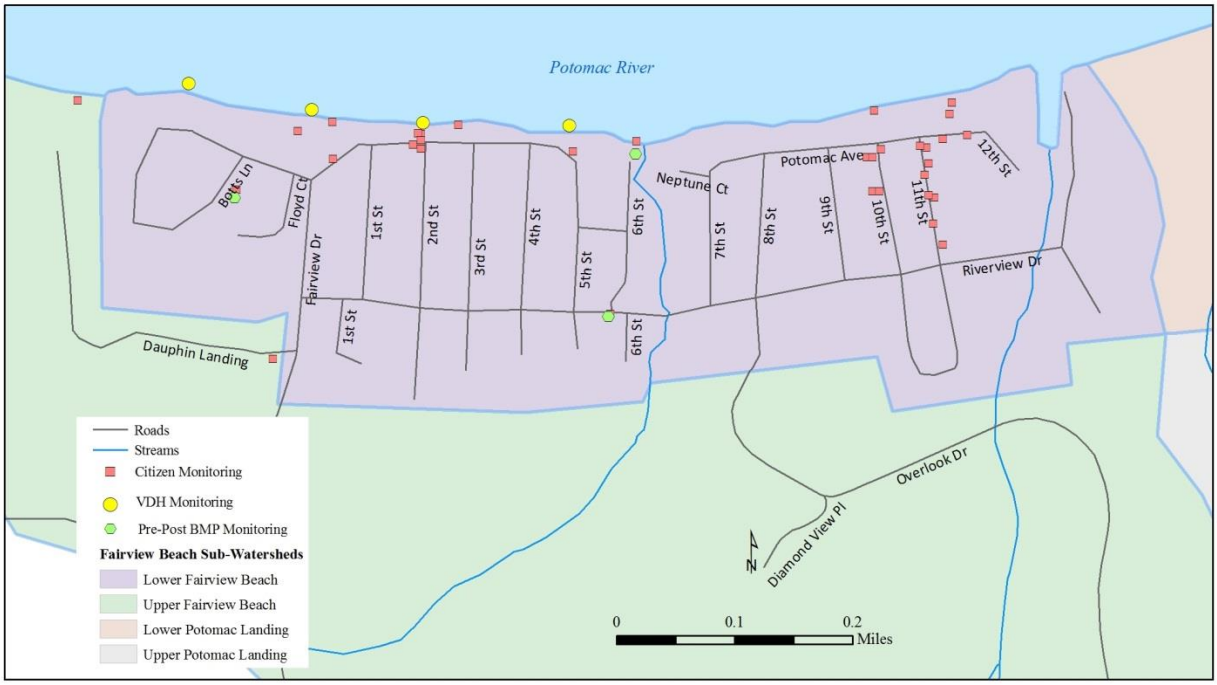
Implementation of proposed BMPs will serve as an interim measure of progress towards achieving the bacteria water quality standard at Fairview Beach. Implementation milestones for tracking purposes are provided in **Chapter 8**. Implementation efforts will be tracked and evaluated periodically, as described in **Chapter 8**, to ensure that adequate progress is being made towards implementation goals.

11 Monitoring

The proposed monitoring program for Fairview Beach builds on the ongoing monitoring (**Section 4.2**) to enable evaluation of trends over time and assess progress towards achieving the water quality standard. DEQ, in collaboration with local partners, will be responsible for periodically evaluating the monitoring data to determine progress towards implementation goals. Proposed monitoring includes 1) continued VDH monitoring, 2) citizen monitoring, 3) pre and post BMP monitoring, and 4) other monitoring (**Figure 11-1**). Each of these is discussed in more detail below. Periodically, additional

source tracking should also be conducted to determine the remaining sources of bacteria. Additional monitoring location(s) may be considered in the Potomac Landing neighborhood.

Figure 11-1. Monitoring locations to quantify progress towards attaining the bacteria water quality standard at Fairview Beach. Note: monitoring locations may be modified as necessary to effectively evaluate trends in water quality conditions over time.



11.1 VDH Monitoring

VDH has monitored *Enterococci* at Fairview Beach since 2004 to issue swimming advisories during the swimming season. DEQ utilizes the VDH data to evaluate attainment of the water quality standards. VDH will continue to monitor *Enterococci* concentrations on a weekly basis during the swimming season on either side of the local beachfront restaurant, at 2nd Street, and at the identified hot spot at 6th Street (**Figure 11-1**). The number and duration of swimming advisories at Fairview Beach, an environmental target described in **Chapter 10**, will be compiled by VDH as part of the monitoring efforts. Continuation of this monitoring effort will allow long-term trends to be evaluated and attainment of the water quality standard to be re-assessed. Collected information will be made available to the general public, FBRA, and DEQ.

Additional funding needs to be identified for this effort. The year 2014 is the last year of currently available funding.

11.2 Citizen Monitoring

As described in **Chapter 4**, FBRA began wet-weather bacteria monitoring using Coliscan kits provided by DEQ in 2011. Although the data are not used to quantitatively assess waterbodies on the impaired waters list, they are useful for indicating the presence and concentration of *E. coli* bacteria. Continuing this wet-weather data collection effort will be critical to measuring the interim impacts of BMP implementation. Previously monitored locations will be given preference to new ones in order to

establish a longer-term database (**Figure 11.1**). DEQ provided monitoring training and will continue to provide equipment and technical advice. EPA 319 funds may be available to support this effort.

11.3 Pre-Post BMP Monitoring

Monitoring downstream of three vegetative buffers (**Figure 11-1**) will determine the effectiveness of BMP installation at reducing bacteria concentrations at these known hot spots. This data will be critical to measuring the interim impacts of BMP implementation. FBRA collected bacteria data at these location in the past; however, additional measurements should be taken prior to and after installation of vegetative buffers. FBRA will be responsible for conducting this monitoring effort using Coliscan kits. DEQ provided monitoring training and will continue to provide the equipment and technical advice.

12 Conclusions

Precursory efforts to this plan, such as water quality monitoring, have been underway for years. ICPRB conducted an evaluation in 2013, with funding and guidance from DEQ, to determine whether a watershed plan approach was appropriate to address the Fairview Beach impairment (ICPRB 2013). Based on the findings of that study and with local support, the decision was made in 2013 to proceed with the development of a watershed plan. Formal preparation of the Fairview Beach Watershed Plan began in January 2014.

The results of the technical analysis indicate that a 73% reduction in bacteria is necessary to meet the water quality standard at Fairview Beach. To achieve this reduction, management measures are proposed that eliminate human and pet sources of bacteria and reduce the remaining stormwater load by 50%.

- Human sources are eliminated by repairing the public sewer system, addressing failing septic systems, and preventing improper disposal of waste from boats.
- Bacteria from pets are addressed through the use of pet waste stations and additional waste pick-up activities.
- Reductions in bacteria sources travelling in stormwater are achieved through a number of management measures designed to slow or capture runoff and increase infiltration to improve water quality (e.g. rain barrels, porous pavement, and vegetative buffers).
- Educational programs will also be a key component of implementation because a number of the management practices will require voluntary changes in behavior.
- Additional measures, such as controlling beach erosion and deterring birds from visiting the beach are designed to further reduce bacteria concentrations at Fairview Beach. In combination, the proposed management activities are designed to address the bacteria impairment within ten years.

Bacteria transport and storage involve complex processes. Prediction of these physical processes is inherently uncertain. Although specific management measures are proposed and their costs are calculated, the final cost of implementation will depend on the extent of measures needed to meet the water quality standard. It may be possible to achieve water quality goals with only Phase 1 implementation. On the other hand, additional stormwater controls may be required during Phase 2 to fully realize the necessary improvements in water quality. To this end, a thorough monitoring program

that includes professional and volunteer monitoring at key locations will inform an adaptive decision-making process for Fairview Beach.

This document is the culmination of significant efforts by local citizens and organizational stakeholders. The Fairview Beach Watershed Plan details the path forward utilizing a practical, implementable approach. However, this document is not the end of the road. Achieving water quality goals at the beach will require ongoing commitment and action by local stakeholders with state support. Modifications to this approach are expected over time based on monitoring and re-evaluation of progress.

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Appendix A. Stakeholder Meeting Minutes and Work Products

This appendix provides the minutes and work products for the stakeholder meetings, listed below. The products from the May 2014 working group meetings included a map to document critical areas for implementation of select management practices (**Figure A-1**) and a management measures worksheet (**Table A-1**).

- September 25, 2013: Public meeting regarding addressing the bacteria impairment at Fairview Beach
- February 22, 2014: Public and CWG meeting
- May 6, 2014: GWG meeting
- May 15, 2014: CWG meeting
- July 10, 2014: SC meeting
- July 23, 2014: Final public meeting

Addressing the Bacteria Impairment at Fairview Beach
Wednesday, September 25, 2013: Fairview Beach Firehouse

Attendees:
Elizabeth Strank, Fairview Beach Resident
Don Pfalzgraf, Fairview Beach Resident
Mike Bennett, Fairview Beach Resident and FBRA Board of Directors member
Janet Harrover, Fairview Beach Resident and FBRA Citizen Monitor
Pam Lane, Fairview Beach Resident
Joe Hancharick, Fairview Beach Resident
Rusty Dennen, FreeLance-Star
Jack Green, King George County
John LoBuglio, King George County Board of Supervisors, Monroe District
Christopher Thomas, KGSA
Scott Sweeney, KGSA
Whit Oversteet, Potomac Riverkeeper
Charlie Lively, TCCSWCD
Tommy Thompson, VDH
Steve Valentine, VDH
Matt Skiljo, VDH
Ross Mandel, ICPRB
Heidi Moltz, ICPRB
May Sligh, DEQ
Jennifer Carlson, DEQ
Bryant Thomas, DEQ

Meeting Highlights:
Presentation - *Analysis of Monitoring Data and Assessment of Sources*

- Summarized data collected by VDH, VT, and Fairview Beach Citizen Monitoring
- Based upon MST sampling by VT:
    - 25% of the bacteria at Fairview Beach is attributable to human sources
    - Bacteria attributable to human sources is found in greater quantity closer to the shoreline as compared to 25 meters out
- Based upon the data collected by the FBRA monitoring:
    - A general correlation exists between the amount of rain and the bacteria concentrations measured
    - Higher concentrations are seen under rough water conditions
- Probable sources of bacteria (controllable):
    - Failing septic systems
    - Faulty sewer connections
    - Dogs
- Primary bacteria transport paths:
    - Stormwater runoff
    - Resuspended sediment and beach sand
- Potential management efforts:
    - Stormwater runoff controls
    - Protection of beach from storms and wave action
- Recommended future monitoring focus:
    - MST analysis of bacteria in stormwater

- Survey of septic systems and sewer connections
- Measurement of bacteria concentrations in beach sand and sediment

Presentation - *Watershed Plans and Implementation*

- Information on developing a watershed plan can be found on EPA's website: http://water.epa.gov/polwaste/nps/handbook_index.cfm, accessed 6/28/2014.
- There are nine main elements that should part of a watershed plan
  - Identify causes and sources of pollution
  - Determine load reductions needed
  - Develop management measures to achieve goals
  - Identify technical and financial assistance to implement plan
  - Develop information/education component
  - Develop implementation schedule
  - Develop interim milestones to track implementation of management measures
  - Develop criteria to measure progress towards meeting watershed goals
  - Develop monitoring component
- Watersheds plans are developed with local involvement
- Public meetings are held, as well as the formation of working groups and a SC
- Potential control measures can have an impact the direct sources of bacteria and manage the runoff from various sources
- Potential funding sources are identified in developing a watershed plan

Discussion Points:

- Potential Sources
  - Sewage pump station near Fairview Drive
  - Population of seagulls – may be seasonal; sightings of eagles
  - Concern surrounds stream upstream of drainpipe
- Watershed plan concerns
  - DEQ can/will take the lead on coordinating the development of the watershed plan, however, local participation is vital to the process
  - It may be possible to have a draft of a watershed plan by next summer
  - The meetings for the development of the watershed plan will be public informational meetings, as opposed to formal public hearings
  - Beneficial to inform volunteers of the details of the plan to understand the time and commitments needed to develop and carry out the plan
  - Carrying out the implementation of the plan is an iterative, on-going process
  - A hired engineer is not required for the development of the plan
  - May want to consider other groups and organizations that may need to be involved (VMRC, Maryland, etc)
- Funding concerns
  - Having local buy-in and support is key to obtaining funds
  - May need to pursue multiple funding sources for adequate funding amounts
  - The lack of a completed TMDL is not anticipated to have a negative impact on obtaining funding, since addressing the water quality impairment is the goal
  - Groups and agencies that can apply for funding will be identified as part of the watershed plan
  - Based on covenants, there is restricted access to the beach. The beach is owned by only a few people, who have granted homeowners access to the beach. Not much can be done to change this. Because of the lack of access, funding opportunities were limited in the past

- Why was 2013 a better year in regard to lower levels of bacteria sampled at the beach?
    - Several possibilities, including:
        - sewer/septic repairs in the trailer park over the past year
        - sampling technique differences
        - less stormy conditions
- Additional Monitoring?
    - There is not any new MST data, most recent was collected 5 years ago
    - Sampling of stormwater is a key goal, can be incorporated into the watershed plan
    - Ideal to perform MST on stormwater, find out the amount of human attributable bacteria is present in stormwater
    - Will investigate the feasibility of performing these type of sampling

Next Steps:

- Distribute notes from September 25, 2013 meeting
- Share *Addressing the Bacteria Impairment at Fairview Beach: Monitoring Data Analysis and Justification for a Watershed Plan Approach* document for review and comment
- Internally, plan for project contracting, workloads, and estimated timeline
- Begin outreach and coordination with stakeholders on the development of the watershed plan

Watershed Implementation Plan for Fairview Beach (Potomac River) in King George County
First Public Meeting
6:00 pm, February 20, 2014: Smoot Memorial Library

Attendees:
Nancy Haenlein, citizen
Charlie Lunsford, DEQ - CO
Steve Valentine, VDH
Mike Bennett, Fairview Beach Residents Association
Herb Cover, citizen
Jim Palmer, ICPRB
Janet Gayle Harris, citizen
Charlie Lively, TCCSWCD
Elizabeth Strank, citizen
Janet Harrover, citizen
Don Pfalzgraf, citizen
Chris Thomas, KGCSA
Jim Howard, KG Supervisor
Ross Mandel, ICPRB
Frank and Salli Hartner, citizens
Tom Hudson, citizen
Jim Lund, citizen
Matt Skiljo, VDH - Richmond
Bryant Thomas, DEQ-NRO
Thomas T. Thompson, VDH
May Sligh, DEQ-PRO
Rebecca Shoemaker, DEQ-NRO
Jen Carlson, DEQ-NRO

The meeting began at 6:00 pm. Michael Bennett, representing the Fairview Beach Association, of which many of the citizens are members, welcomed attendees and introduced May Sligh. Presentations were given by the consultant, ICPRB and DEQ staff. The working group session began right after the formal presentations. For the most part, meeting comments followed the question guidelines provided to each attendee (in bold below).

Initial Comments:

- Can we say that there are likely two known 'hot spots' (Pavilion and 6th/7th Streets) and there may be others? (Ross replied yes)
- There are drainage issues related to construction above 6th Street; will runoff be a part of this program? (May replied yes, if runoff contributes to bacteria loading and there is land on which BMPs can be implemented.)
- Can we look at the impacts of the seawalls that were installed to control erosion? Will this project support installation of seawalls? (May noted that these structures are intended for sediment reduction from beach erosion. There may be instances where such structures are connected to bacteria reduction needs associated with this project. Ross offered to evaluate the potential benefits (bacteria reductions) to improving the beach infrastructure.)
- It was noted that the project will not get into surveying and engineering. It was then asked why we would apply band-aids instead of getting into the surveying and engineering that may be needed.

Are there any other bacteria sources besides those listed in the studies?

- There has been an increase in feral cats in the community. Could they be contributing to the bacteria loads? There seems to be a lot of skunks in the area recently. What about them? (May replied that educational materials could be geared towards spaying/neutering cats, and we would not address wildlife concerns right away. Both likely have negligible contributions as compared to humans and pets.)
- A number of people felt strongly that the infrastructure problems still existed. Finding the leaky laterals by using dye testing and/or smoke testing is strongly recommended. Who is required to be on the sewer system? (Staff will coordinate with the KGCSA on this)

What is the local perception of straight pipes, failing systems and sewered areas in the community and are there areas where there are known problems? Are there poor soils in the area? What control measures should be used?

- The trailer park septic systems should be a priority for connecting to sewer. Don't think they were required to connect to sewer, and those that did may still be improperly connected. The owners have had the development for a long time but it may be in the process of changing ownership, with the possibility of a townhome development. 90 townhomes were proposed at one time, so if there could be capacity for such an increase why not capacity for the trailer park? VDH thought there were some septic tanks there that were difficult to get to due to additions to the trailer structures.
- Drainfields in concave areas should also be a priority for connection or repair/replacement. Sometimes drainfields flood from runoff uphill and home downspouts that lead directly to the drainfields.
- Are there any straight pipes in Fairview Beach? (Health Department replied that there are probably not many)
- There are good sandy soils in Fairview Beach. However, there are places where the water table is close to the surface and where drainfields may have been compromised by landscaping and construction. Also the lots are very close together, so space for proper treatment may be a concern in some cases.
- BMPs are needed to address runoff and flooding problems, such as rain gardens and rain barrels, and larger drainage swales that could capture runoff, slow it down and allow it to percolate into the soil.
- In areas where homes were hooked up to sewer, there is not a record of the old septic tanks being pumped out and closed out, though there could be some instances where they exist. (VDH said not likely many of these though)
- The western section of the park has an eroding riverbank, and some is very close to some drainfields. A survey should be done to see where these homes exist. Perhaps we can track sewer system connections by tracking which households get sewer bills.

What programs already exist to help get information to homeowners, and what methods work best for reaching citizens? Is there a need for education and outreach on septic system operation and maintenance?

- Mailings should be sent to the owners of trailers, not the renters, to determine where problems exist and the methods for correcting them.
- The best outreach methods are newsletters, websites, educational brochures, and special events. Going door to door may be necessary. There may be opportunities to reach visitors with important information too, like picking up after pets.
- Some residents may need information on proper septic maintenance. Residents do get pump-out notices since they are in the Chesapeake Bay Act area, but not sure how well it is being enforced.

- The Tri County City Soil and Water Conservation District can help develop educational materials with VDH, and both can offer technical advice to residents on septic system maintenance. TCCSWCD may also help administer a cost share program for residents to address deficiencies in their septic systems.
- In some cases there may be assistance to help residents with the cost of connecting to sewer.

What is the public perception about pets/dogs being a bacteria source? Are there areas of the community where composters could be promoted?

- The community is probably divided 50/50 on whether it is important to pick up after their pets.
- For those that do not participate, offering them some educational material and leash bag holders may help, but some attendees thought that it would be tough to convince some people of the importance.
- For pet owners with dog runs, and multiple dogs, there may be an interest in using the buried composters, which break down the material by using enzymes. These could be available through a cost–share assistance program, possibly administered by the TCCSWCD, to encourage homeowners to purchase and install them.

Note from C. Lunsford: "Buried composters" – seems to be referring to the Doggie Dooley which is actually best described as a "pet waste digester" as opposed to composter which is generally shown as an above ground process with a trash can or commercial unit. I think it is better to describe the pet waste digester being suitable for 1-4 dogs based on the models available. Pet owners with "dog runs" and "multiple dogs" implies more than 1-4 and would generally require other means of waste management than in-ground digester(s)."

Are there areas where public dog walking takes place, and where dog bag and disposal stations could be installed?

- FBRA has worked with TCCSWCD to install ten pet waste stations in the community, and one attendee said she keeps the bags filled. They also provide information in the "welcome packet" for new residents so they know that picking up pet waste is expected of them. One pet waste station is broken, and TCCSWCD said they could replace it for them.
- Education for boat owners on pet waste is a good idea, because some people let their dogs run on the beach once they get off their boats. One person had been seen covering up the waste, which is not appropriate, so some information and leash bag holders could be very helpful at getting the expectation across to visitors too.
- Offer leash bag holders and brochures at special events, like Aquapalooza.

Are there concentrations of dogs, like kennels and boarding facilities, which could be considered potential sources?

- There are not any kennels or vets in the community, but it may be helpful to use area vets to get educational material and leash bag holders distributed to citizens.
- Again, there is a concentration of cats.

Is there a need for local ordinances?

- Someone stated that there is a county leash law ordinance that applies to Fairview Beach. (Post meeting research indicates that according to the Fairview Beach bylaws, dogs are required to be on a leash at all times at Fairview Beach, in compliance with county and state regulations. The bylaws also say that pets shall be under control of their owners at all times on the beach. In the event that one's dog or cat defecates on the beach, the owner is responsible for proper removal and disposal.)

Is there a need for education and outreach on pasture management for horse owners and other animals? What is the best way to reach them?

- There are some goats on the hill, and some well-cared for horses near the community entrance. There may be a need to reach the horse owners with pasture management information so that animals are rotated around the property to reduce soil compaction, erosion and runoff. It would be good to know how horse manure is being managed on the land too. The TCCSWCD would reach out to them with the variety of options that would suit their particular farming operation.

Is there a concern about boat discharges near Fairview Beach? Is there a need for educational materials geared specifically for boaters? Is there a concern about boaters throwing waste overboard, or "passing the bucket"?

- There is a concern about boat discharges in the beach area. One citizen said they'd seen "evidence" of boat waste near the shore.
- VDH said the pump-out station at the marina is currently in disrepair, but that they are working with the owner to correct deficiencies. There is grant money available to them to assist with repairs.
- Often boaters come from far away. The anchor out in the Potomac River and are shuttled into land. Providing boaters with educational brochures, and with leash bag holders if they have a dog, could be very helpful. The Clean Marina Program has some material that could be used to educate boaters. A sign showing that there is a pump-out station available to boaters would be a good idea too, once it is repaired. Anything that can be done to reduce the likelihood of them dumping their holding tank out in the Potomac before coming into shore would be good, since it was felt that that material may migrate toward Fairview Beach eventually.

Are there opportunities to improve stream buffers in the area? Do you know of specific areas where this may be possible?

- Improvements to buffers are needed along the mainstem of the Potomac, in the area where erosion problems persist. Native trees and shrubs could be used to help hold the soil in place.
- Buffers could be used in common areas of the community, but there may be also residential areas that would greatly benefit from buffers. C. Lunsford explained how he'd used native ornamental grasses along his riverfront property in the Northern Neck. Their strong root system helped reduce erosion, which was critical to property protection. The grasses also provide nutrient removal from any overland runoff, and provide songbird habitat. A citizen inquired about maintenance, and C. Lunsford advised that it was necessary to hand trim the grasses periodically. This may be a challenge, as the current maintenance approach in these common areas is to mow grasses down mechanically. The advantage of these native grasses is that they help anchor the bank, while also being low enough that residents can enjoy their river views.
- Another citizen expressed concern about the maintenance of something different than turf. They have a few bushes there, and they already have a hard time maintaining around them too. It would take some time to educate those doing the landscaping.
- One citizen shared that they placed a native grass in their yard to help absorb runoff, and even thought it was difficult to plant each sprig by hand that it has helped soak up rainwater on their property. Plus it has been very low maintenance.

At the end of the meeting, Matt Skiljo added that the funding from EPA to monitor bacteria at Fairview Beach would no longer be available after 2014. May stated that evaluating other funding sources to carry out the monitoring after 2014 would be part of the watershed plan. As well, if 319 funds are used there is typically a monitoring component, for both hotspot and post-BMP monitoring.

The next item on the agenda was to select individuals for the SC. The representatives from the community are: Janet Harrover, Michael Bennett, Don Pfalzgraf, and Herb Cover. The group will assist with reviews of the draft document, working group ideas and presentation materials for the final public meeting, which is expected to be in **August**.

May Sligh will advise attendees of the links for presentation materials as soon as they are posted on the DEQ website. She will also advise of planned meeting dates.

The 30-day public comment period on the information presented at the meeting will end on March 24, 2014. Questions or information requests should be addressed to May Sligh with the DEQ-Piedmont Regional Office by phone at (804)450-3802 and by e-mail at may.sligh@deq.virginia.gov or to Jennifer Carlson with the DEQ – Northern Regional Office by phone (703)583-3859 and by e-mail at jennifer.carlson@deq.virginia.gov. Though e-mail comments are preferred, written comments and inquiries can also be submitted and should include the name, address, and telephone number of the person submitting the comments. Please send to May Sligh, **Department of Environmental Quality, Piedmont Regional Office, 4949-A Cox Road, Glen Allen, VA 23060.**

Watershed Implementation Plan for Fairview Beach (Potomac River) in King George County
GWG Meeting
1:00-3:00 pm, May 6, 2014: Smoot Memorial Library

Attendees:
Tommy Thompson, VDH
Chris Thomas, KGSA
Charlie Lively, TCCSWCD
Katie Wallet, TCCSWCD
Jim Howard, KG Supervisor
Steve Valentine, VDH
Sheryl Stevens, Draper Aden (consultant to KGSA)
Heidi Moltz, ICPRB
Rebecca Shoemaker, DEQ
May Sligh, DEQ

The meeting began at 1:00pm. May Sligh welcomed attendees and explained that since this was a "work session" there would be no formal presentation. Rather, the group would use the projected spreadsheet to evaluate load reduction strategies already included and consider others that may have merit. May explained that the group would follow the five tasks identified in the GWG fact sheet: identify funding sources and technical resources presently available, evaluate additional programs/technical resources that could enhance implementation, identify lead agencies for business and residential implementation support, consider regulatory controls currently in place or needed that could induce actions to improve water quality in the impaired watersheds, discuss monitoring component. For the most part, meeting comments followed the spreadsheet categories in bold (below). As well, a large map of the community was used to identify possible BMP locations (color coded dots were used).

Infrastructure:

- How many septic? It is unknown. Even those that are hooked to sewer may still have tank; it is possible that sewer lines were drilled through tanks.
- Is it possible to require info about septic abandonment when sewer connection is made? If not, it may be a good idea so that there is a record of old tanks. This is not a state requirement – it is by locality. They'd need a new ordinance.
- **Chris Thomas can provide the names of all sewer connections.**
- Smoke test offered through a supplemental environmental project, but it was rejected by DEQ b/c fixing all the house connections could not be included. (May – there is cost-share funding to connect malfunctioning septic systems or straight pipes to public sewer)
- VDH – trailer park (TP) drain field may be in a large field, which may feed to the drainage way that is problematic (violations after storm events). The TP was identified on the map. VDH said the septic tanks were underneath some of the trailers on the south side of park.
- VDH said that the folks in TP have to pump-out their tanks often, more than should be required
- Trailers are largely owned by one person; there is a maintenance person that is the liaison between the owner and the community (Mike Shrewsbury). The trailer park has been rezoned for townhomes (since 2009). When redeveloped, sewer connections will be required.
- A dye test could easily be done for the TP clean-outs that are most suspect
- Jim Howard mentioned that Jack Green, KG Planner, said there were no records of pump outs from the TP (for their CB Act five year pump-out requirement).
- KGSA will take the septic waste at the wastewater treatment plant, but only if from KG.

- May have to go with the band-aid approach with TP rather than hook up because of the possibility that property owner may redevelop area for townhomes.
- Also houses on septic that are closer to sewer may be added too.
- Is it possible to help with the connection fees? They are about $11K. (May has checked since the meeting and yes, construction and tap fees are included in the cost share program but there are caps for the different cost share rates: 50% = $4500, 60% = $5400, 70% = $6300, 75% = $6750.
- VDH – there are funds to help with fixing the marina pump-out; pump-out is connected to the sewer, but it is not being used. If it is fixed, it will need to be treated as a septic due to extra chemicals that may be included in boat treatment systems. KGSA will evaluate this issue.
- It may be possible at some point to have a mobile pump-out unit in the area to handle special events and high-use weekends. Preston Smith with VDH may be able to assist with this.

Education:

- VDH can provide some info about basic septic maintenance; how to best disseminate info to trailer park? Possibly through the TP maintenance staff.
- Citizen mentioned that only ½ of the folks in Fairview Beach are members of FBHA, but they can still place materials on the website.
- Stores can distribute educational flyers.
- The leash bag stations are fine but this area not suitable for the dog waste composters.
- Attendees were fine with all other programs suggested in the spreadsheet.

Pasture:

- There is some equestrian activity to the west of Fairview Beach.
- There are a small number of goats in the upper Fairview Beach watershed.

Monitoring:

- VDH monitoring will end this year; we can get grant funding to continue monitoring as part of BMP pre and post. However, we also want to do monitoring to mimic what VDH has been doing – can our grant money go to VDH so that they can continue the monitoring? Since this is the best way to evaluate whether bacteria levels are safe for swimming, efforts will be made to incorporate this type of sampling too.
- VDH said they'd seen progress last year (2 closures) and hope to see again in 2014 Watershed

Runoff Reductions:

- Where can we add rain gardens? Chris Thomas suggested drainage way at trailer park; drainage way between 6th and 7th Streets.
- May needs to look into implementation of BMPs on private land – does the area fall under an easement on the deed? DEQ would handle this with a "Transfer of Responsibility of Installed BMPs" form, obligating new owner to maintain the BMP. May will check further on the deed restrictions.
- Charlie Lively stated that it may be best to do a BMP, such as a rain garden, on common area so that residents can see how they work and to create interest in implementing BMPs on residential land. The goal would be to do that first.
- Who owns the land up on the top of the bluff? May will check with FBRA on these details. All roads are maintained by the state. VDOT will address the bank erosion that occurs in their right-of-way. There is more erosion with each big storm.

The next item on the agenda was to select an individual for the SC. The representative from the GWG is Charlie Lively, TCCSWCD. This group will assist with reviews of the draft document, working group ideas and presentation materials for the final public meeting, which is expected to be in **August**.

May Sligh will advise attendees of the links for presentation materials as soon as they are posted on the DEQ website. She will also advise of any future planned meeting dates. May thanked attendees for assisting with the spreadsheet updates and additions to the map.

Questions or information requests should be addressed to May Sligh with the DEQ-Northern Regional Office by phone at (804)450-3802 and by e-mail at may.sligh@deq.virginia.gov.

Watershed Implementation Plan for Fairview Beach (Potomac River) in King George County
CWG Meeting #2
6:00-8:00 pm, May 15, 2014: Smoot Memorial Library

Attendees:
Tommy Thompson, VDH
Charlie Lively, TCCSWCD
Katie Wallet, TCCSWCD
Etta Lucas, TCCSWCD
Mike Bennett, citizen
Janet Harrover, citizen
Don Pfalzgraf, citizen
Mike Broaddus, VCE
B.J. Strank, citizen
Jim Howard, KG Supervisor
Heidi Moltz, ICPRB
Jim Palmer, ICPRB
Rebecca Shoemaker, DEQ
May Sligh, DEQ

The meeting began at 6:00 pm. May Sligh welcomed attendees and explained that since this was a "work session" there would be no formal presentation. Rather, the group would use the projected spreadsheet to evaluate load reduction strategies already included and consider others that may have merit. May explained that the group would address the following: evaluate the current list of strategies (spreadsheet), evaluate additional programs/technical resources that could enhance implementation, identify groups for business and residential implementation support, consider regulatory controls currently in place or needed that could induce actions to improve water quality in the impaired watersheds, discuss monitoring component. For the most part, meeting comments followed the spreadsheet categories in bold (below). As well, a large map of the community was used to review locations identified by the GWG and identify additional BMP locations (color coded dots were used).

Infrastructure:

- Tommy Thompson shared that he found info about location of septic tanks in the files; we should identify each septic tank so that we can track requirement of five-year pump-out; we are not aware of any failed drain fields, so cannot require them to connect to sewer (a problem would be seen when the waste surfaces); Mike Shrewsbury can help us get access to the septic systems to do dye testing at the trailer park.
- Someone else said that Mike Shrewsbury is key to reaching the people in the trailers.
- Some trailers are closer to the sewer line and are hooked into the sewer line. There were six hooked in illegally and the PSA corrected. It's believed there may still be some connected improperly.
- VDH said there was no fee to abandon the septic system. They must pump-out and fill in septic tank. It was also noted that VDH does not have records of abandoned septic tanks that currently exist in Fairview Beach.
- VDH also shared that the marina boat pump-out station has been repaired.
- Someone asked why the trailer park was not required to hook into the sewer when the houses were. Jim Howard: If they were in the sanitary district, then they were required to hook up to sewer; will look into where the sanitary district boundaries lie.

- May: what are the county rules for hooking into sewer? Jim Howard said there may be new laws under consideration that require hook up at time of property transfer.
- We need to evaluate the cost-benefits of repairing failed septics and hooking folks up to sewer, especially in trailer park.
- Someone mentioned the following: Rural Development may have assistance for the trailer park (especially senior citizens?), but this may or may not help since the trailers are rented. There is a DEQ cost share practice for alternative septic systems (like peat and mound) that may be an option for systems where conventional systems have failed or replace an identified straight pipe in situations where the installation/replacement of a septic tank system cannot be permitted.

Education:

- Septic system education needed at Grandview Estates (behind firehouse).
- Visitors by boat need information and free bags because they bring dogs ashore to do their business. Suggestion from someone in the group: install a sign at the beach focused on getting boaters to pick up their pet waste.
- Educational brochures should be carried on the two water taxies operated by the restaurants.
- Attendees were fine with all other programs suggested in the spreadsheet.
- It was suggested that the FBRA website could be used as one mechanism to distribute educational materials.

Pasture/Livestock:

- 25 caged chickens found (off Smiths Warf Rd); waste collected in tubs and put on garden. There are 1100 acres available to spread.
- There are possibly some goats also in the watershed
- A letter was provided by Mike Broaddus, documenting the livestock found in the watershed

Monitoring:

- VDH monitoring will end this year; we can get grant funding to continue monitoring as part of BMP pre and post. However, we also want to do monitoring to mimic what VDH has been doing – can our grant money go to VDH so that they can continue the monitoring? Since this is the best way to evaluate whether bacteria levels are safe for swimming, efforts will be made to incorporate this type of sampling too.
- VDH said they'd seen progress last year (2 closures) and hope to see again in 2014.
- Hotspot monitoring locations should be on each side of restaurant and at 2nd and 6th Streets.
- Citizen monitors need more supplies and plan to continue monitoring especially after storm events.

Runoff Reductions:

- Where can we add rain gardens? Attendees were unsure of any beyond what the GWG identified in spreadsheet.
- The county may limit the type of vegetation used at the bluff. Someone mentioned that grass has been planted on the bluff 3x and last year it was fertilized. There was some discussion about putting up another retaining wall to stabilize the slope. Also it was noted that ~30' of beach was lost in the last hurricane.
- Tom Hudson added that with respect to the beach erosion strategies, we do not need any work on the groins or additional breakwater structures. He said the breakwater with groins at 5th Street works well and the ones at 3rd and 4th Streets work fairly well.
- The county now requires BMPs: when the impervious area on the lot exceeds 16%, stormwater BMPs are required; we need to get info from county on the details and if possible where the BMPs are already located in Fairview Beach.

- What can be done with the corner of 3rd and Fairview? There is a grate that does not appear to be connected to a drainage pipe. Jim Howard will speak to VDOT.
- Methods for reducing seagulls as a source of bacteria are needed.

The next meeting will be with the members of the SC. This group will assist with reviews of the draft document, working group ideas and presentation materials for the final public meeting, which is expected to be in late July.

May Sligh will advise attendees of the links for presentation materials as soon as they are posted on the DEQ website. She will also advise of any future planned meeting dates. May thanked attendees for assisting with the spreadsheet updates and additions to the map.

Questions or information requests should be addressed to May Sligh with the DEQ-Northern Regional Office by phone at (804)450-3802 and by e-mail at may.sligh@deq.virginia.gov.

Watershed Implementation Plan for Fairview Beach (Potomac River) in King George County
Steering Committee Meeting
1:00-3:00 pm, July 10, 2014: Smoot Memorial Library, 1:00-3:00 pm

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Attendees:
Tommy Thompson, VDH
Katie Wallet, TCCSWCD
Jack Green, KG Planning
Jim Howard, KG Supervisor
Janet Harrover, Fairview Beach Residents Association (FBRA)
Don Pfalzgraf, FBRA
Herb Cover, FBRA
Mike Bennett, FBRA
Heidi Moltz, ICPRB
Ross Mandel, ICPRB
Rebecca Shoemaker, DEQ
May Sligh, DEQ

The meeting began at 1pm. May Sligh welcomed attendees and explained that since this was a "work session" there would be no formal presentation. Introductions were made and the Community and Government Working Group representatives (Janet Harrover and Katie Wallet, respectively) were recognized. The group was asked to first review the power point presentation developed by May Sligh, to be used at the July 23rd public meeting. Four copies of the draft Watershed Plan were shared for attendees to reference during the presentation. After the presentation review, the working group reports were provided to the SC by their representatives (content included in this summary). As well, a large map of the community with possible BMP locations was placed on the wall for reference during the discussions.

Presentation Review:

- Slide 1 – add KGSA, add FBRA Citizen Monitors
- Control Measure Quantification slide – Ross will help with a few summary slides to summarize the various studies
- Bacteria loading slide – need to note the sources, time period, assumptions, extrapolations for Potomac Landing
- Bacteria loading slide – suggestion to change the table to % reductions rather than use the exponential values for bacteria loads from sources
- Measures slide – put the feral cat education at the bottom of the list
- Costs slide – make this shorter

General Discussion:

- May referred to the monitoring section of the draft watershed plan and explained that much of this section will be moved to the Appendix.
- Herb asked if we can add more source testing as a task in the plan; he said that the last testing was performed in 2007; since then, there have been adjustments to the sewer and installation of the waste stations – May thought that we could add the BST type testing, in case it can be covered by the 319 funding monitoring support. Heidi will also help explain the 75% reduction goal.
- Mike asked if we should try to personally invite Potomac Landing residents to the meeting – May agreed and FBRA citizens would help find contacts so May can brief them on the work done.

May also added that the public meeting was in the Free Lance Star and on Public Register, but to her knowledge no one from that neighborhood came to the 1st public meeting. May will make every effort to get them up to speed on the project and see that they have representation at the July 23rd meeting.

- Mike asked if we could include in the report the new VDH monitoring information that Tommy passed out during the meeting (possibly add it as an appendix); additionally, Katie suggested that we include this information at the public meeting – May thought that this would be a good idea too, and we can add to the appendix, since it shows more recent swimming advisory information since the sampling that was done for the watershed plan.
- Mike asked if there was a way to get grant funding for smoke testing; it was noted that we need to make sure the report includes smoke testing (not just dye testing) – May said we can include both. Tommy said they recommended the dye testing for the trailer park section. There was also a discussion about the Supplemental Environmental Project negotiations between DEQ and KG County and that May understood that they can't move forward unless there is a commitment to fix problems they find with the smoke testing. If smoke testing is not done before the project phase, may see about other sources of funding.
- Mike mentioned that Chris at the KG Service Authority told him that there is a suspect drainage pipe under the parking lot, near Tim's II; May noted that we will use project funding to find specific issues such as this, i.e. dye or smoke testing. Someone added that it was near the #2 location on the large map.
- It was noted that Chapter 11 of the report should also state that VDH monitoring should be continued in the future.
- General discussion about implementing an ordinance to require septic system records:
    - Jack noted that the septic system records do not exist;
    - Tommy noted that we need a program by which VDH can record abandonment of septic systems when sewer connections are made;
    - It was noted that we cannot require an ordinance because of Dillon's Rule, but we can encourage participation. VDH and county can commit to communicating better on this matter.
- Mike and Herb asked why the BST indicates that birds account for so much of the bacteria load; Ross noted that "birds" as a source indicate no resistance to antibiotics and that bacteria in this category could also be bacteria that was re-suspended in sand.
- Janet noted that she would like future monitoring to include 6th street, which was not included in the past – May added that all of the details for a monitoring plan will be worked out during the project phase. The 319 implementation projects include a monitoring plan that covers hotspot testing and BMP effectiveness testing.
- It was noted that the easternmost VDH monitoring site should be moved slightly to the west on the existing monitoring map – Heidi made a note of this.
- Katie asked that we provide a very clear and concise background of the project on July 23rdfor those who have not been involved from the plan development beginning. Focus on educating them on the problem and the proposal for corrections.
- Mike will do the public meeting opening greeting and will also present the project background.

The next item on the agenda was to hear the reports from Janet Harrover and Katie Wallet. Here are their summaries:

Summary of Community Working Group Meetings, by Janet Harrover:

Since 2004 Fairview Beach has had many beach advisories issued by the VDH as a part of the Beach Monitoring Program. The results of these tests have put us (Fairview Beach), on the list of impaired waters.

After several meetings with the local community, local government agencies, and under the direction of the DEQ it was determined that the best approach to try to improve the Fairview Beach area was to create a Watershed Plan.

There have been two public meetings for the purpose of working up a Watershed Implementation Plan.

The first meeting held on February 20, 2014, began with a presentation of background information and analysis given by Ross Mandel from the ICPRB. Jennifer Carlson & May Sligh from DEQ followed with an overview of the steps and focus items in developing a Watershed Plan for Fairview Beach.

During the working session we discussed the questions prepared by DEQ with most attention given to known existing problem areas. Some of those areas being the trailer park septic issues, pet and other animal waste in the community, boaters and the possibility of them dumping human waste in the river as well as their pet waste when coming on shore, and storm water management and its impact on Fairview's large erosion problems.

A four member steering committee was formed.

The second Community Working Group meeting was held on May 15, 2014, with DEQ presenting a large map identifying the Watershed boundaries and a spread sheet identifying the current list of different strategies. In this session we worked through the different items on the spreadsheet. Some of those items included the identified problem areas, and necessary information needed to track these issues such as, source, location for implementation, potential funding sources, technical resources, programs to help with implementation, and lead Agency. Again most attention seemed to be on sewer and septic issues at the Trailer Park area.

Summary of Government Working Group Meeting, by Katie Wallet:

The following agencies were represented at this meeting on May 6, 2014: VDH, KGSA, TCCSSWCD, King George County Board of Supervisors, and ICPRB.

This meeting resulted in a great collaboration of all in identifying the locations of existing water quality problem areas, possible BMP locations, and solutions.

Infrastructure was discussed first which led to a very detailed discussion pertaining mostly to septic systems. It was affirmed that the most probable area of concern is the trailer park. Testing has been done to confirm this. Education and Outreach will play a role in remedying this situation.

It was noted that agriculture and pasture areas are not a component in the water quality degradation of this watershed.

Water Quality monitoring will need some extra attention as the grant funded program will end this year.

Lastly, runoff reduction solutions for various locations were discussed. Installing BMPs on private land would be preferable due to the locations of problem areas.

May thanked Janet and Katie for their reports. She will send attendees the draft watershed plan on July 11th. She asked that they get comments to her by COB July 16th to give the contractors time to integrate corrections. May asked that they all assist with getting the word out about the July 23rd public meeting, especially for the Potomac Landing residents.

Questions or information requests should be addressed to May Sligh with the DEQ-Northern Regional Office by phone at (804)450-3802 and by e-mail at may.sligh@deq.virginia.gov.

Watershed Implementation Plan for Fairview Beach (Potomac River) in King George County
Final Public Meeting
6:00 pm, July, 23, 2014: Smoot Memorial Library

Attendees:
Tommy Thompson, VDH
Steve Valentine, VDH
Jim Howard, KG Supervisor
Izabela Sikora, TCCSWCD
Charlie Lively, TCCSWCD
Janet Harrover, Fairview Beach Residents Association (FBRA)
Don Pfalzgraf, FBRA
Herb Cover, FBRA
Mike Bennett, FBRA
Salli Hartman
Tim Ruppalt
Karen Ruppalt
Mr. McDonald, Potomac Landing resident
T.C. Collins, Potomac Landing HOA
Heidi Moltz, ICPRB
Ross Mandel, ICPRB
Charlie Lunsford, DEQ
Bryant Thomas, DEQ
Rebecca Shoemaker, DEQ
May Sligh, DEQ

The meeting began at 6 pm. Mike Bennett welcomed attendees and provided background on the community and project, including the fact that already this year there had been 16 days of swimming advisories due to excessive bacteria at Fairview Beach. He's concerned about the vulnerability of children who come to swim during the summers at Fairview Beach. With 25% human bacteria sources in the watershed, it's a real problem and we ought to be able to use this plan to get things done. He stated that he appreciated DEQ staff leadership and the very interesting and well-written report. He introduced May Sligh who pointed out the project team members and began the power point presentation. A discussion, summarized below, followed the presentation.

General Discussion:

- Tommy Thompson: VDH can provide info about costs associated with beach monitoring; he suggested that we use a local lab (if certified) instead of sending to Richmond.
- Herb Cover: FBRA applied for grants in the past for erosion work, and they did not qualify because of the private beach. Can we expect the same response in the future?
- May: Any stormwater related solutions will focus first on common land; 319 funds may be used on private properties, as well. When upland stormwater solutions are connected to the community beach and bank erosion problems, sources of funding may be more available to a more holistic solution.
- Tim Ruppalt: Will Virginia get a "rain tax" similar to Maryland?
- Charlie Lunsford: Localities with MS4 will probably be looking at fees in the future; landowners can get credits for implementing BMPs.

- May: Some communities already have stormwater utilities to help defray the costs of stormwater BMP maintenance. Incentive programs are also in place in some communities for the installation of rain barrels, rain gardens, etc.
- Don Pfalzgraf: The report includes hooking up septic to sewer = 40 homes in Phase II?
- May: We cannot put in sewer connections for land that will likely change to townhomes, but we should address faulty septic systems throughout the community. The more immediate solution to the area in question is to repair septic systems.
- Don P.: They are working on determining timeframe for townhome development.
- May: The plan can be adapted if we receive more info about this in the future.
- Tommy T.: We (VDH) can sample at some of the cleanouts in the future to determine where problems exist.
- Potomac Landing resident: Why does VDH not inspect for compliance unless someone reports a problem?
- VDH: This county does not go to homes unless asked (partly because of limited resources); Mike Shrewsbury has always been helpful to VDH and VDH plans to keep working with him when there are problems; VDH can only go by what is reported as sewage on the ground.
- May: We should focus on doing dye testing to evaluate problems in the trailer park, and then we will work through the landowner for the whole neighborhood to provide the most efficient response.
- Bryant: Make sure the report includes a sanitary survey as a recommendation.
- Don: Is smoke testing appropriate for trailer park?
- May: It was determined in last meeting that dye test is most useful for septic (smoke is for sewer system).
- Charlie Lunsford: Suggested we use smoke to find illegal hook-ups to the sewer system.
- Tim Ruppalt: What about the muddy area around the pipe at the beach?
- Ross Mandel: This area has been tested and had high concentrations of bacteria.
- VDH: The source could not be determined because there was not enough water in the sample.
- T. C. Collins: In the plan I observed that there are no samples in Potomac Landing area.
- May: Potomac Landing benefits from Fairview Beach testing; would we want to put monitoring at PL in the plan?
- T.C. Collins: I need to check with the board to see if they want to monitor.
- Mike Bennett: If we get 319 funds, is there a federal compliance aspect (trailer park)?
- Charlie Lunsford: 319 is not necessarily meant for septic issues – it's really for non-point sources, but years ago we were able to get septic practices included in the cost share programs funded through 319 as the faulty systems regularly show up in bacteria loading evaluations.
- Bryant: If there are issues with the collection system, the water authority's permit has a compliance issue. Problems should be resolved through the permitting process.
- VDH: There has been pushback against VDH sampling; when we posts signs west of 2nd Street, the signs are then removed.

May thanked everyone for their participation and attendance. She reminded them of the August 25th comment deadline and provided the link to the document and presentation. They were encouraged to share the information with their neighbors. The meeting adjourned at 8:00 pm.

Questions or information requests should be addressed to May Sligh with the DEQ-Northern Regional Office by phone at (804)450-3802 and by e-mail at may.sligh@deq.virginia.gov.

Figure A-1. Working map utilized to document critical areas for implementation of select management practices. Green circles represent known agricultural activity. Red circles indicate areas with septic systems. Yellow circles with "SW" identify areas for placement of swales.

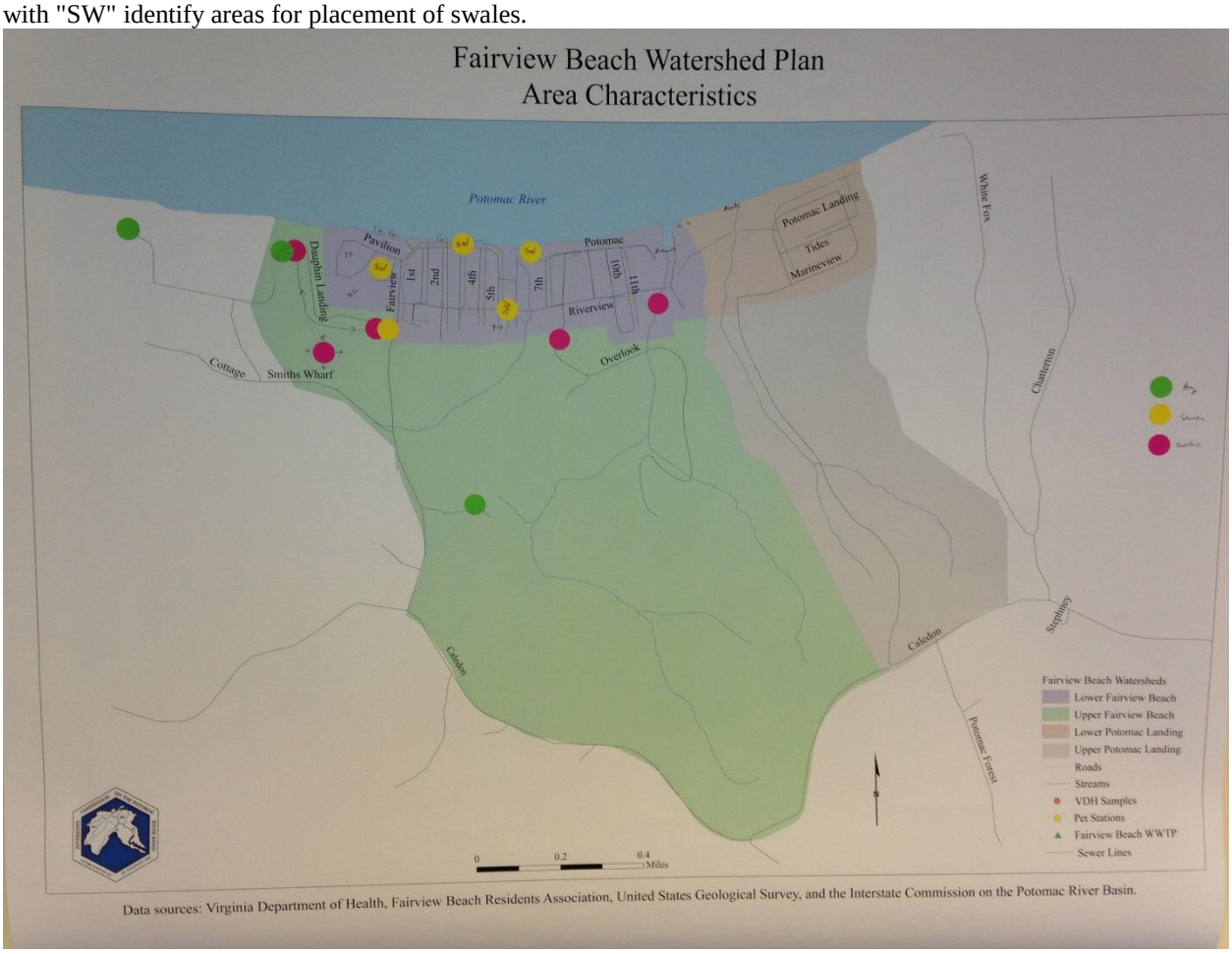


Table A-1. Draft management measures worksheet – presented as filled in during the May 2014 GWC and CWG meetings.

Type	Measure	Source	Location for Implementation	Specific Locations (mark on map and/or note here)	Potential Funding Sources	Technical Resources	Additional Programs to Enhance Implementation	Lead Agency (current and needed)	Monitoring / Measures of Success	Questions/ Comments
Infrastructure	Improve sewer system by finding and fixing leaking laterals using dye/smoke testing	Human	KGSA sewer system	KGSA system (and trailer park to test for interconnections)	Combine SEP and cost share	VDH and KGSA	Educational programs	VDH and KGSA		
	Dye test septic systems in the trailer park to determine which ones are failing	Human	Trailer park		Minimal cost ?	Records of previous dye/smoke testing	RB-2 and/or RB-3, discussed below	VDH, Mike Shrewsberry - Trailer park manager		
	Ensure that boat pump-out station at marina is maintained in working order	Human	Marina pump-out station	Marina	Cost share through VDH clean marina program for repairs, when necessary	VDH and KGSA	Educational program for boaters	VDH (Preston Smith)	Monitoring may be required by KGSA to ensure the quality of the waste stream, similar to the monitoring required by septic haulers	
	Boat that collects waste from other boats during high traffic times	Human	Potomac River near Fairview Beach			Other programs (e.g. Smith Mountain Lake)	Educational program for boaters	VDH (Preston Smith)	Record weights	
	Pump and close old/unused septic tanks (RB-2, only in connection with concurrent sewer connection)	Human	Inside sewer service area	See map	319	VDH and KGSA		VDH or TCCSWCD to manage grant	Record the number of systems pumped/closed each year	

Type	Measure	Source	Location for Implementation	Specific Locations (mark on map and/or note here)	Potential Funding Sources	Technical Resources	Additional Programs to Enhance Implementation	Lead Agency (current and needed)	Monitoring / Measures of Success	Questions/ Comments
	Hook up remaining septic users to sewer (RB-2)	Human	Near existing sewer lines	See map	319	VDH and KGSA	If a drainfield is failing, the owner can be made to connect to public sewer (if in sewer service area)	VDH or TCCSWCD to manage grant	KGSA record number of new sewer connections	
	Address flooding drainfields	Human	Low-lying areas outside of current sewer service boundary	See map		Results of dye or smoke testing	Repairing and pumping out septics	VDH	Number of drainfields fixed	
	Repair workable septics (RB-3)	Human	Outside KGSA boundary	See map	319	Industry standard for conventional septic systems	Educational programs; VDH has diagrams of septics to identify locations and address problems and require pump-out every 5 years (CB Act)	VDH	Number of systems repaired	
	Septic tank pump-out (RB-1)	Human	Locations with septic	See map	319	Industry standard for conventional septic systems	Educational programs	VDH	Septic pump service records of number of tanks pumped	
Pet Waste	Pet waste stations	Dogs	10 locations (TCCSWCD and FBRA) in Lower Fairview Beach	See map	TCCSWCD, FBRA and 319	ICPRB	Educational programs	TCCSWCD, FBRA	Weigh the waste before disposal to estimate bacteria reduction	Weighing performed by waste collection service
	Pet waste pick-up (volunteer or service)	Dogs	Beach or strategic public areas that drain to the beach		TCCSWCD, FBRA		Educational programs	TCCSWCD or FBRA ?	Weigh the waste before disposal to estimate bacteria reduction	
Runoff Reduction (upland areas)	Rain barrels	Stormwater	Residences and community buildings		NFWF	ICPRB	Educational programs	TCCSWCD	Number installed	Map rain barrel

Type	Measure	Source	Location for Implementation	Specific Locations (mark on map and/or note here)	Potential Funding Sources	Technical Resources	Additional Programs to Enhance Implementation	Lead Agency (current and needed)	Monitoring / Measures of Success	Questions/ Comments
										locations in GIS
	Redirecting downspouts onto grassy areas	Stormwater	Residences and community buildings		NFWF		Educational programs	TCCSWCD ?	Number redirected	Map locations of redirected downspouts
	Porous pavement	Stormwater	Low-intensity use areas in private and public areas such as driveways, sidewalks, parking lots	Fire house, homeowners with paved driveways	NFWF, VCAP?	DEQ, Chesapeake Stormwater Network, VA BMP Clearinghouse	Outreach to encourage proper maintenance	FBRA for common areas	Area installed (reduction in impervious surface)	Are there other commercial properties that would consider this?
	Encourage low impact development techniques	Stormwater	Plan area	Jack Green may have info on stormwater BMPs already installed under existing county ordinance	NFWF	DEQ, Chesapeake Stormwater Network, VA BMP Clearinghouse	King George County ordinance: newer houses forced to put in BMPs since 2008, cannot have >16% impervious cover; VA Stormwater Management Program	DEQ, King George County		Storm pipes need to be reworked at 3rd and Fairview (VDOT)
	Redevelopment opportunities in the trailer park area	Stormwater	Trailer park	Re-zoned area - trailer park	Trailer park owner and potential developer	George Washington Regional Commission, King George County planners	Encouraging low impact development techniques; sewer hook up	King George County ?		Does anyone have a copy of the proposed plans?

Type	Measure	Source	Location for Implementation	Specific Locations (mark on map and/or note here)	Potential Funding Sources	Technical Resources	Additional Programs to Enhance Implementation	Lead Agency (current and needed)	Monitoring / Measures of Success	Questions/ Comments
	Vegetative buffers or turf to trees	Stormwater	Private lands and residential common areas along eroding bluff	See map	319, NFWF, VA DOF Urban Tree grant	DEQ buffer manual, VDOF Urban Trees program, VA BMP Clearinghouse,		TCCSWCD ?	Opportunity for pre-post BMP monitoring	Who owns the bluff? Grass has been planted 3 times on the bluff and it has been fertilized
	Rain gardens	Stormwater	Plan area	Start with common property (maybe abandoned KGSA well site) to demonstrate	319, NFWF, VCAP?	TCCSWCD workshops and online list of resources, VCAP	Use demonstration site to encourage private property installations	TCCSWCD ?	Number installed	
Beach	Repair bulkheads and enhance with vegetation	Beach erosion	Beach	Beach	NFWF	SEAS?		DEQ		Not stand alone practice - must be combined with upland sw reductions
	Increase width of beach by 10-15 yards	Beach erosion	Beach	Beach	NFWF	SEAS?	Re-vegetation/ stabilization efforts	DEQ		Lost 30' of beach in the last hurricane
Wildlife management	Discourage birds from visiting the beach	Birds	Beach	Tims II and 4 piers at 6th St		Other programs (e.g. Chicago Gull Management Project)	Garbage control			Birds on piers in winter
Education Programs	Feral cat population control education program	Cat	Plan area		Potential partnership with SPCA to spay/neuter cats					Cats not a significant bacteria source
	Mailings to trailer park owner to determine where problems exist	Human	Trailer park				Dye/smoke testing	Mike Shrewsberry - Trailer park manager	Better informed tenants, communications about problems to owner/manager	

Type	Measure	Source	Location for Implementation	Specific Locations (mark on map and/or note here)	Potential Funding Sources	Technical Resources	Additional Programs to Enhance Implementation	Lead Agency (current and needed)	Monitoring / Measures of Success	Questions/ Comments
	General education program	All	Newsletters, websites, educational brochures, and special events	Store near trailer park, FBRA website, Grandview Estates, water taxis operated by restaurants (Ricks and Tims II)	319	Could use existing pamphlets as a starting point (e.g. VDH) or develop new ones to cover all residential practices		TCCSWCD		
	Proper septic maintenance education program, including educational materials, technical advice	Human	Areas outside of the sewer service boundary	Store near trailer park, FBRA website		Could use existing pamphlets as a starting point (e.g. VDH) or develop new ones to cover all residential practices		TCCSWCD, VDH		
	Leash bag holder distributed for pet owners	Dogs	Areas frequented by pet owners	Community dog owners and visitors	319		Pet waste stations	TCCSWCD	Number distributed	Always distribute leash bag holders with educational brochure
	Recreational boater education program	Human and Dog	Areas frequented by recreational boaters	Brochures at marina, businesses	319		Repair marina pump station	TCCSWCD, VDH		
	Encourage more inspections of boats by the Coast Guard Auxiliary	Human	Near Fairview Beach on the Potomac River	(auxiliary person in the area is land-based)	N/A			Coast Guard Auxiliary	Number inspected	

Type	Measure	Source	Location for Implementation	Specific Locations (mark on map and/or note here)	Potential Funding Sources	Technical Resources	Additional Programs to Enhance Implementation	Lead Agency (current and needed)	Monitoring / Measures of Success	Questions/ Comments
	Participate in Virginia Clean Marina Program	Human	Marina		No cost for program participation per se - marina improvements cost share through marina program	Virginia Clean Marina Guidebook	Keep pump-out station in working order	Virginia Clean Marina Program	Certification of marina	
	New ordinance that requires records of old septics during property transfer or hook up of system to sewer	Human	FBRA? or King George County?	Throughout sewer service area	King George County ?	King George Planners	RB-2	King George County	Adoption of ordinance	
Monitoring	Continue VDH monitoring	All	Beach	Continued monitoring at VDH locations along the beach (2nd St, each side of Tims II, and 6th St)	Existing funding ends this year - need to find additional funds; 319?			VDH		
	Pre-post BMP monitoring	All		See map for possible swale monitoring locations	319 ?			FBRA?		
	Hot-spot monitoring	All	Drainway	Continued monitoring on previously identified hotspots like drainway	319 ?	Results from previous monitoring efforts	Continued VDH monitoring	FBRA		

Appendix B Monitoring Data Collection and Results

This section describes in more detail VDH's bacteria monitoring at Fairview Beach. In addition to the monitoring performed by VDH, additional monitoring, including MST and sampling for OBs, has been performed in cooperation with VDH by VT Department of Crop and Soil Environment under the direction of Professor Charles Hagedorn. The goal of this sampling was to determine the sources of bacteria impacting Fairview Beach. VT actively monitored Fairview Beach between 2004 and 2009. More recently, on November 18, 2013, VDH and VT also monitored bacteria in the water column and sediment at multiple locations following a storm event to help determine the impact of local stormwater on bacteria levels at the beach.

Since 2011, the FBRA has worked with the DEQ to perform bacteria monitoring using Coliscan kits provided by DEQ. This section will also analyze and summarize the VT and FBRA monitoring data.

B.1 VDH Monitoring Results

Starting in 2004, VDH monitored *Enterococci* concentrations on approximately a weekly basis, May through September, in the vicinity of Fairview Beach. In 2004 and 2005, VDH monitored at four sites, shown in **Figure B-1**. The location of site D was approximated from a description of its location by VT (2004). Monitoring at Site D was discontinued in 2006. VDH issues a swimming advisory if the arithmetic average *Enterococci* count exceeds the assessment threshold of 104 cfu/100 ml. VDH reports its results by site number (Site #1, Site #2, etc.). The site numbers have changed from year to year. Based on reports and communications, **Table B-1** reconstructs the location of VDH site numbers over the 2004-2013 monitoring period.

Figure B-1. VDH monitoring station locations. Note: location of Site D is estimated from VT (2004).

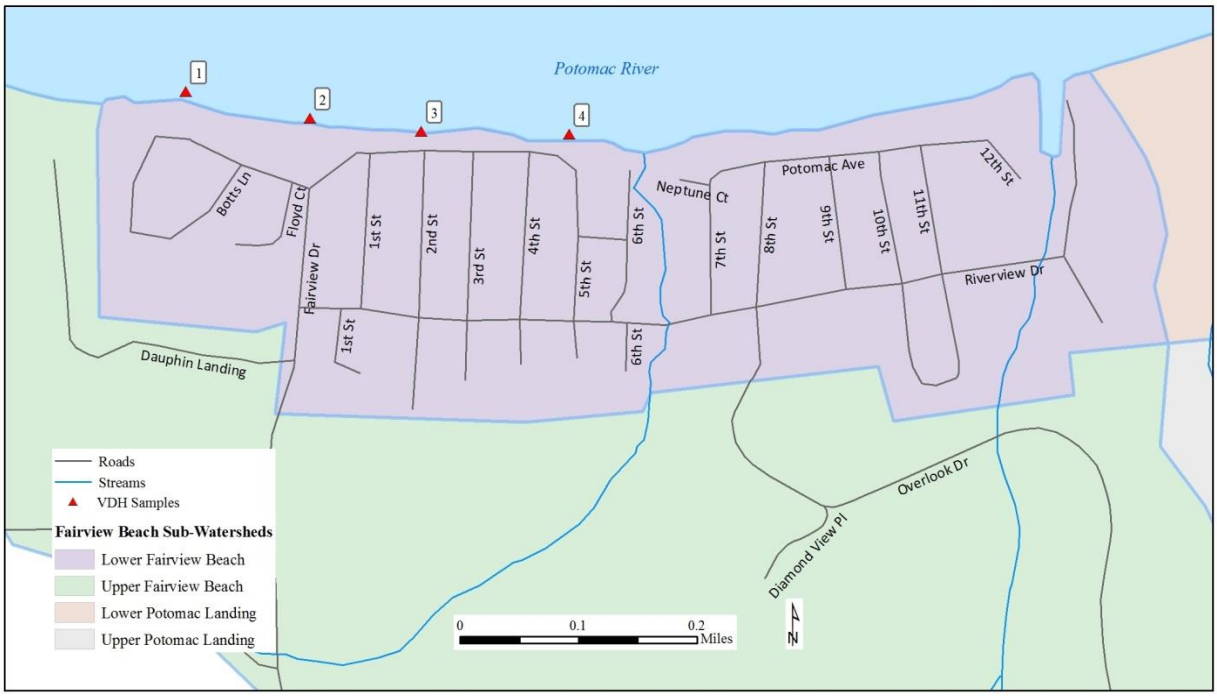


Table B-1. Location of VDH monitoring sites as shown in **Figure B-1**[1].

Year	A	B	C	D
2004	4	1	3	2
2005	4	1	3	2
2006	4	1	3	
2007	3	1	2	
2008	3	1	2	
2009	3	1	2	
2010	3	1	2	
2011	3	1	2	
2012	1	2	3	
2013	1	2	3	

[1]Based on Cover et al. (2011); VT (2004); personal communication, T. Thompson, 8/23/2011.

Table B-2 summarizes VDH *Enterococci* monitoring results by the locations shown in **Figure B-1**. In calculating the summary statistics for **Table B-2**, concentrations below the detection limit were set at the detection limit. Values labeled "Too Numerous to Count" (TNTC) were set at 24,191 cfu/100 ml, which is the maximum value used by VDH when calculating the daily average concentration across sites. These rules will be used in all summary calculations throughout this report. Monitoring data for the 2014 season is not included in these results; however, the 2014 data is provided in **Appendix C**.

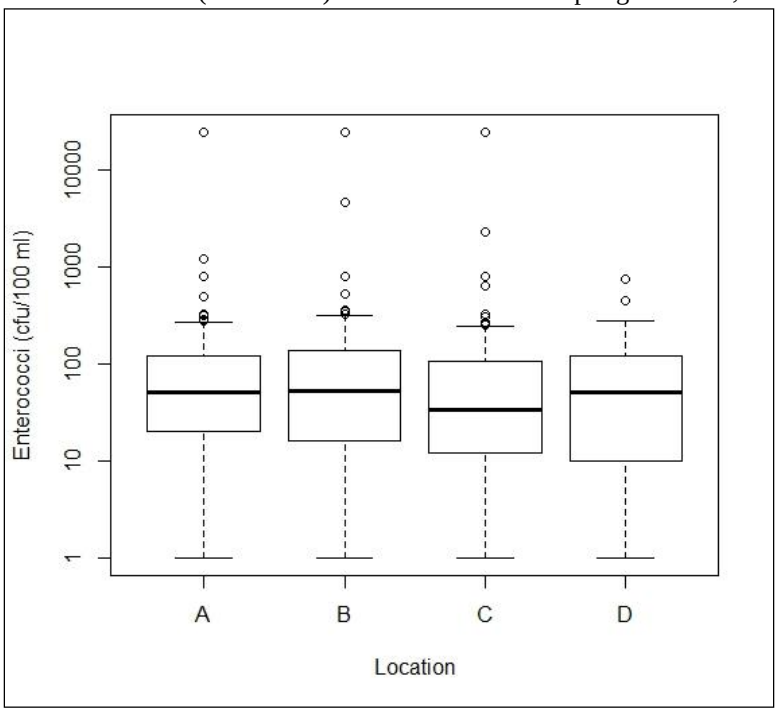
Table B-2. VDH *Enterococci* monitoring results (cfu/100 ml) by location.

Statistic	A	B	C	D	Arithmetic Average[1]
Count	201	204	203	40	204
Minimum	1	1	1	1	2.7
10th Percentile	10	10	10	5.5	11.3
25th Percentile	20	16	14	10	17.3
Median	50	50	36	51	55.5
75th percentile	120	115.5	99	115.75	122.8
90th Percentile	270	304	260	214	273.0
Maximum	24,191	24,191	24,191	730	24,191.0
Average	689.1	467.5	446.0	98.2	529.7
Std. Deviation	3,765.3	2,924.7	2,921.5	140.0	2,903.2
Geometric Mean	53.1	47.9	40.4	34.8	55.6

[1]Summary statistics of arithmetic average by sampling date used to determine advisories.

Approximately 30% of the average values are above 104 cfu/100 ml. There does not appear to be statistically significant differences among the locations. A Kruskal-Wallis test failed to detect a difference in the median concentration among the stations. **Figure B-2** shows boxplots of the distribution of observed *Enterococci* concentrations at the VDH sampling locations. This does not take into account the fact that since 2004 two sources of bacteria have been identified and mitigated, as will be discussed in the subsequent section.

Figure B-2. *Enterococci* concentrations (cfu/100 ml) observed at VDH sampling locations, 2004 -2013.



VDH swimming advisories are based on a single day's observations. There are sufficient observations in VDH monitoring results to compare them to Virginia's monthly geometric mean *Enterococci* criterion. **Table B-3** gives the monthly geometric mean concentrations for months in which there are at least four weekly values. The monthly geometric mean is calculated using the arithmetic mean of the daily observations. Geometric mean values exceeding the 35 cfu/100 ml criterion are shown in red. About two-thirds of the months have mean values above the criterion. There was no year in which four samples were taken in the month of May, so a geometric mean was not calculated for May samples.

Table B-3. Monthly geometric mean *Enterococci* concentrations (cfu/100 ml), Fairview Beach (based on daily arithmetical average concentration).

Year	June	July	August	September
2004	46	6	17	112
2005		84	64	
2006	149	27	7	
2007	136	43	69	52
2008	60	80	24	216
2009	84	31	39	88
2010	28	32	42	
2011	177	15	75	
2012	44	56	31	
2013	69	34	26	

Monthly concentrations above the 35 cfu/100 ml criterion are shown in red.

B.2 VT Monitoring Results

VT staff sampled *Enterococci* concentrations, measured OBs and performed MST at Fairview Beach during the swimming season during 2004 to 2009. The monitoring was performed at the VDH sampling locations but also at other sites to test specific hypotheses about the source of bacteria at Fairview Beach. These other sites included:

- Sinkhole at 8th Street,
- Drainpipe at Pavilion Drive,
- Potomac River and neighboring embayments,
- Caledon Natural Area State Park, and
- Fairview Beach Yacht Club marina and boating events.

MST and OB measurements were not performed at every site. **Table B-4** shows the analyses performed for each site type.

Table B-4. VT analyses performed (2004-2009) by site type.

Site Type	*Enterococci*	MST	OBs
VDH sites	X	X	X
8th Street Sinkhole	X[1]	X	X
Drainpipe	X	X	X
Potomac River	X		
Caledon State Park	X		
Boating and Marina	X	(marina only)	

[1]2004 samples were not analyzed for *Enterococci* concentrations.

The MST methodology used at Fairview Beach 2004-2009 was Antibiotic Resistance Analysis (ARA). In ARA, the responses of bacteria to a battery of antibiotics are tested. Isolates are classified according to the similarity in response when compared to known sources. For Fairview Beach the sources of bacteria were classified as 1) birds, 2) wildlife, 3) human, or 4) dogs or pets (the VT reports refer to pets and dogs interchangeably).

OBs, also known as fluorescent whitening agents (FWAs), are chemical additives put in laundry detergents to brighten clothing (Hagedorn et al. 2005a and 2005b). They are also added to hand soap and toilet paper. OBs are discharged with wastewater and can therefore be used as an indicator of the presence of wastewater. The presence of OBs is detected using an instrument called a fluorometer, whose measurements must be calibrated against known sources. OBs are reported in fluorescence units. In a study of septic system pollution in the Coan River, Hagedorn et al. (2005b) found that MST detected a strong human signature whenever OB measurements were 89-90 and greater; in their studies of Fairview Beach, VT (2005, 2006, and 2007) considered OB measurements over 100 as positive tests for the presence of wastewater.

Subsequent monitoring performed in November 2013 to investigate the impact of stormwater on bacteria concentrations at the beach used genetic testing to help determine the source of bacteria. Monitoring results for this event are discussed in **Section B.4**.

B.2.1 VT Sampling Results at VDH Sampling Sites

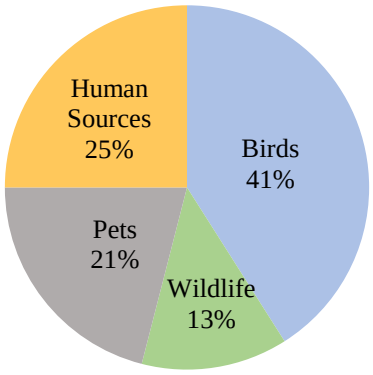
The most significant result of VT MST is the detection of a strong human signature at Fairview Beach at the VDH sampling sites. In 70% of the samples analyzed at these sites, at least one isolate from human sources was identified.

The relative contribution of sources over multiple samples can be calculated by assuming that the sources of observed bacteria are proportional to the fraction of isolates in a sample from those sources (**Eq. B-1**). In other words, the bacteria attributable to a source can be defined to be:

Bacteria attributable to source in sample = Sample bacteria concentration * number of isolates from source/total number of isolates **Eq. B-1**

Using this formula and summing the bacteria counts attributable to sources over all samples, about 25% of the observed bacteria can be attributed to human sources. **Figure B-3** shows the breakdown by source. Based on the observed data, about half the bacteria observed at Fairview Beach can be attributed to human sources or pets (primarily dogs).

Figure B-3. Observed bacteria attributable to sources, Fairview Beach, 2004-2007.



The fraction attributable to anthropogenic sources (human and pets) is slightly larger if only samples with bacteria concentrations larger than 104 cfu/100 ml are included in the analysis. For these samples, 26% of the observed bacteria can be attributed to human sources and 22% to dogs. There are positive trends between observed concentrations and percent bacteria attributable to human or anthropogenic sources. **Figure B-4** shows the correlation between observed concentrations and the percent of those concentrations attributable to human sources; **Figure B-5** shows the correlation between concentrations and percent attributable to anthropogenic sources. Higher percentages attributable to these sources tend to be associated with higher observed concentrations. High bacteria concentrations, however, are also observed when the percent of the bacteria attributable to anthropogenic sources are relatively low. If the fraction of bacteria attributable to anthropogenic sources is subtracted from observed bacteria concentrations, about 30% of the average daily *Enterococci* concentrations would still be above 104 cfu/100 ml.

Figure B-4. Percent isolates attributable to human sources vs. observed *Enterococci* concentration (cfu/100 ml), Fairview Beach, 2004-2007.

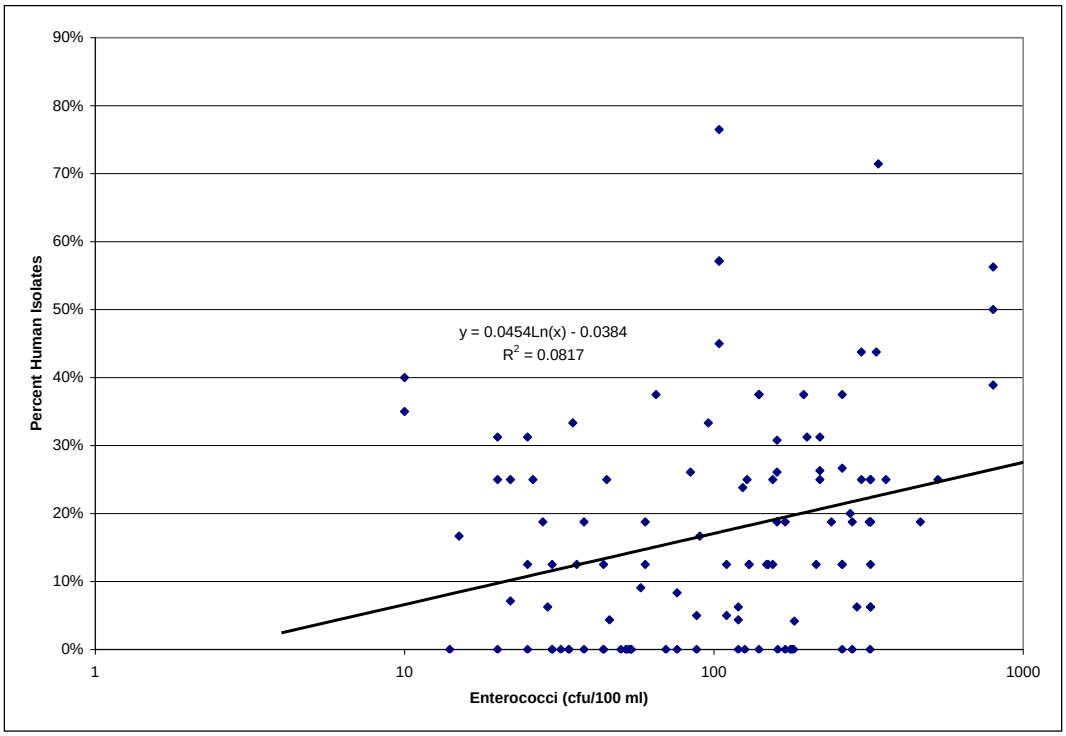
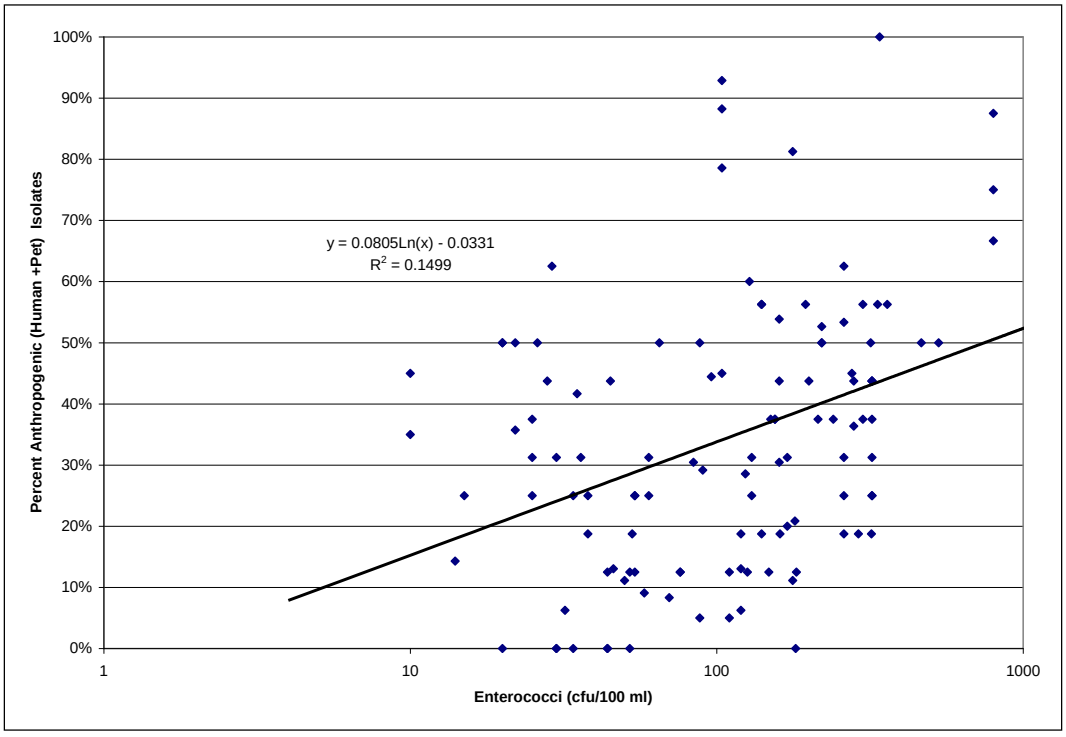


Figure B-5. Percent isolates attributable to anthropogenic sources vs. observed *Enterococci* concentration (cfu/100 ml), Fairview Beach, 2004-2007.

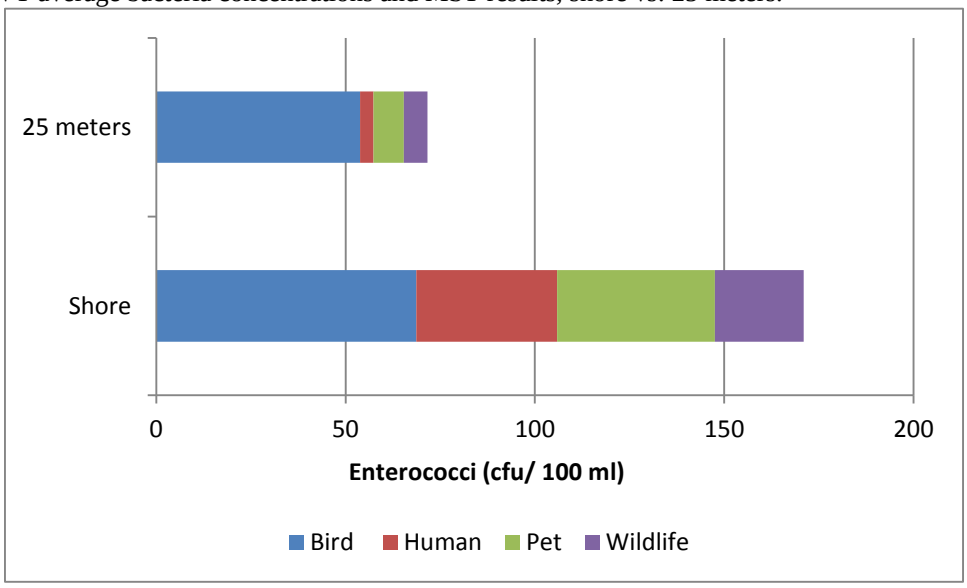


To further evaluate the human signature detected in the bacteria observed at Fairview Beach, VT staff conducted several studies in 2007 and 2008 to attempt to identify potential human sources of bacteria at Fairview Beach. To test whether the Potomac River is the source of human signature at Fairview Beach, VT took three paired samples, one at the VDH sampling location, and one 25 meters out into the Potomac River. No OB measurement was greater than 100 and, although human isolates were found, generally birds were responsible for the greatest number of isolates. Nevertheless, in all paired samples, 1) the concentration of *Enterococci*, 2) OB fluorescence measurements, and 3) the number of isolates attributable to human sources were less in the samples taken 25 meters out into the Potomac River than in the samples taken closer to shore. **Table B-5** shows the results of the paired sampling events. **Figure B-6** compares the average concentrations at the shore and 25 meters out as well as the average fraction of isolates attributed to sources.

Table B-5. Paired sampling monitoring results (VDH sampling locations vs. 25 meters out into Potomac River), Fairview Beach.

Date	Station	Position	*Enterococci* (cfu/100 ml)	Optical Brighteners	Isolates				
					Bird	Human	Pet	Wildlife	Total
6/23/2006	A	Shore	318	70	7	3	5	1	16
		25 m	140	46	11	1	2	2	16
	B	Shore	214	64	8	2	4	2	16
		25 m	90	54	13	0	1	2	16
	C	Shore	465	95	5	3	5	3	16
		25 m	175	67	12	1	2	1	16
7/13/2006	A	Shore	220	70	6	5	3	2	16
		25 m	50	47	13	1	1	1	16
	B	Shore	195	68	6	6	3	1	16
		25 m	65	53	10	2	2	2	16
	C	Shore	155	66	8	2	4	2	16
		25 m	73	45	13	0	2	1	16
5/30/2007	A	Shore	38	60	10	3	1	2	16
		25 m	14	36	10	0	1	1	12
	B	Shore	36	46	9	2	3	2	16
		25 m	21	34	9	0	3	0	12
	C	Shore	45	77	7	4	3	2	16
		25 m	17	47	11	1	0	0	12

Figure B-6. VT average bacteria concentrations and MST results, shore vs. 25 meters.



B.2.2 8th Street Sinkhole

In 2004, VT staff performed MST analysis and measured OBs at a sinkhole at 8th Street, as well as a storm drain at 8th Street. A strong human signal was detected at the 8th Street sinkhole. OBs also measured 171 on 6/24/2004. The sinkhole was filled in with concrete at the end of the summer. Samples were taken the following year on 6/15/2005 inside and at the end of the 8th Street storm drain, as well as at the end of the pier on 8th Street. No human isolates were detected at any of these locations, and OB measurements were below 40, suggesting that filling in the sinkhole had prevented human signal found in the sinkhole from reaching the river. No explanation of the source of the human signal was ever determined. **Table B-6** shows the sampling results taken in the vicinity of the 8th Street sinkhole.

Table B-6. VT sampling results in vicinity of 8th Street, Fairview Beach.

Date	Location	*Enterococci* (cfu/100 ml)	Optical Brighteners	Isolates				
				Bird	Human	Pet	Wildlife	Total
6/15/2004	Storm drain	*	40	7	3	4	10	24
6/15/2004	Sinkhole	*	78.7	3	9	6	6	24
6/24/2004	Sinkhole	*	171	2	10	3	9	24
6/15/2005	Storm drain	220	32.4	8	0	2	6	16
6/15/2005	Storm drain (inside)	670	37.8	18	0	0	2	20

* Sample not analyzed for bacteria.

Because the sample taken at the end of the pier adjacent to the storm drain on 8th Street on 6/15/2005 had an *Enterococci* concentration less than 10 cfu/100 ml, no MST analysis was performed on the sample.

B.2.3 Pavilion Drive Storm Drain

A storm drain, which starts at Pavilion Drive and discharges to the Potomac River just upstream of the swimming area, became the focus of investigation starting in 2006. VT sampled the storm drain

and the sand at the mouth of the drain in 2006 and 2007 and found elevated *Enterococci* concentrations and isolates attributable to human sources. The drain, but not the sand, was sampled for OBs and levels were about 100, indicating the presence of human sources. **Table B- 7** shows the monitoring results from the storm drain, and **Table B-8** shows the results from the sand.

Table B-7. VT monitoring results from Pavilion Avenue drainpipe, 2006-2007.

Date	*Enterococci* (cfu/100 ml)	Optical Brighteners	Isolates				
			Bird	Human	Pet	Wildlife	Total
6/23/2006	158	112	6	5	4	1	16
7/13/2006	560	119	7	6	3	0	16
5/30/2007	317	121	7	6	3	0	16
7/17/2007	380	57	8	7	1	0	16
9/2/2007	1440	213	6	8	2	0	16
9/3/2007	4220	127	5	8	3	0	16
9/4/2007	4460	188	5	9	2	0	16

Table B-8. VT monitoring results from sand below Pavilion Avenue drainpipe outfall, 2006-2007.

Date	*Enterococci* (cfu/100 ml)	Isolates				
		Bird	Human	Pet	Wildlife	Total
6/23/2006	180	5	6	4	1	16
5/30/2007	680	6	7	2	1	16
7/17/2007	1175	3	8	3	2	16
9/2/2007	460	5	9	2	0	16
9/3/2007	600	5	9	2	0	16
9/4/2007	2300	4	8	3	1	16

Additional samples were also collected from the water beneath the sand to the right and left of the drain. Observed *Enterococci* concentrations were 540 and 195 cfu/100 ml at the right and left, respectively. Nine of sixteen isolates were attributed to human sources at the right of the pipe and eight of sixteen isolates were attributed to human sources at the left. OB measurements were 113 and 121, respectively, confirming the presence of bacteria from human sources.

An intermittent creek flows into the storm drain above Pavilion Drive. The creek was sampled once on 7/13/2006. The observed *Enterococci* concentration was 1780 cfu/100 ml. Seven of sixteen isolates could be attributed to human sources, and the OB measurement was 149, corroborating the presence of wastewater.

At the end of the swimming season in 2007, the King George County Health Department investigated the sewage disposal systems in a trailer park and apartment building adjacent to the storm drain (Burkett 2007). The trailer park occupies the area along Botts Lane, Floyd Court, and Pavilion Drive west of Botts Lane (See **Figure B-1**). The investigation was done with the full cooperation of the owners of trailer park. Some of the trailer homes are served by septic systems, and some are connected to public sewer lines. One drainfield which lies between trailer homes on Pavilion Drive and the Potomac River was found to functioning properly, but two other septic systems were replaced with connections to the public sewer system. Dye tests, with subsequent investigation with transducer and camera, uncovered two breaks in the sewer lines connecting trailer homes with the public sewer system. Effluent from these breaks had entered the Pavilion Avenue drainpipe and discharged to the river. The breaks were repaired. VT staff sampled the drainage pipe for *Enterococci* in 2009. **Table B-9** shows the monitoring results.

VT (2009) characterized the bacteria counts observed in 2009 as "lower overall" than previous years, but as **Table B-9** shows, observed *Enterococci* concentrations were frequently above the 104 cfu/100 ml assessment criteria. At the close of the swimming season in 2011, another sewer line break in the trailer park was discovered and repaired. Sampling performed by FBRA in the vicinity of the drainage pipe will be discussed below.

Table B-9. Observed *Enterococci* concentrations (cfu/100 ml) at Pavilion Avenue drainpipe, 2009.

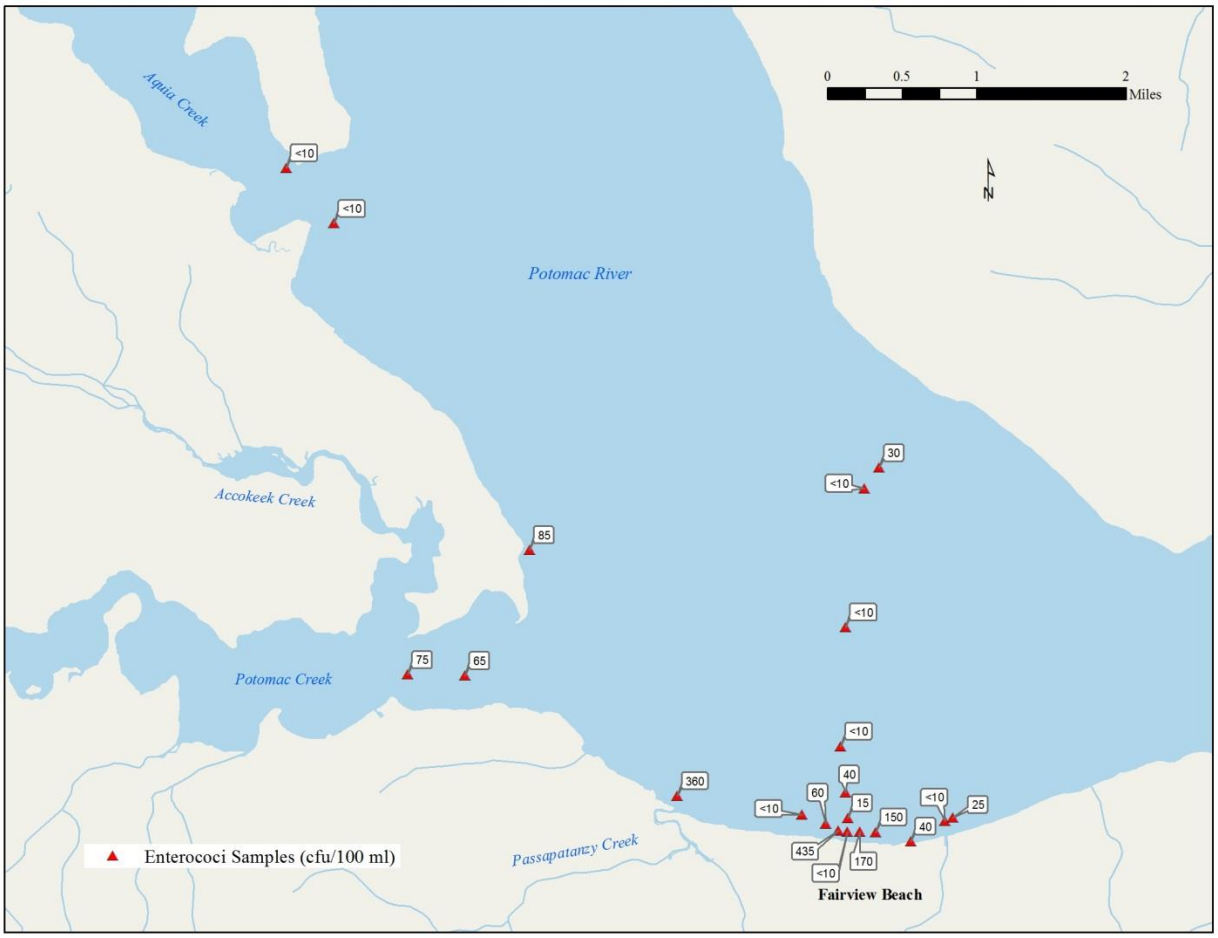
Date	*Enterococci* (cfu/100 ml)	Date	*Enterococci* (cfu/100 ml)	Date	*Enterococci* (cfu/100 ml)
5/21/2009	190	7/13/2009	350	8/17/2009	20
6/2/2009	860	7/21/2009	120	8/24/2009	60
6/22/2009	100	7/27/2009	140	8/25/2009	230
6/25/2009	670	8/3/2009	790	9/1/2009	830
6/27/2009	210	8/5/2009	170	9/2/2009	120
6/29/2009	90	8/6/2009	30	9/6/2009	580
7/6/2009	380	8/10/2009	10	9/9/2009	240

B.2.4 Potomac River

To investigate the source of high bacteria concentrations at Fairview Beach, VT staff sampled the Potomac River and several Virginia embayments for *Enterococci* and OBs in 2007 and 2008. MST was not performed on the samples.

Sixteen sites in the Potomac River, two in Aquia Creek, and two in Potomac Creek were monitored on 7/17/2007. **Figure B-7** shows the *Enterococci* concentrations observed at these locations. Only four of the sixteen concentrations were above 104 cfu/100 ml, and three of these were in close proximity to Fairview Beach. A fourth sample, collected in the Potomac River near the mouth of Passapatanzy Creek, had a concentration of 360 cfu/100 ml. The possible significance of that sample is discussed below in **Section 4.3.3**. The maximum OB measurement observed in the Potomac River samples was 68. Concentrations sampled on the same day at VDH sites A, B, and C were 155, 355, and 24 cfu/100 ml, respectively.

Figure B-7. Observed *Enterococci* concentrations (cfu/100 ml) in Potomac River and embayments, 2007.



Quantitative data from 2008 are unavailable. VT (2008) states that sampling in 2008 "discounted the river as the source of problems at Fairview."

B.2.5 Caledon Natural Area State Park

To test whether wildlife may be the source of high bacteria concentrations at Fairview Beach, VT staff sampled the waters off the Caledon Natural Area State Park (see **Figure 2-1**) for *Enterococci* and OBs in 2007 and 2008. MST was not performed on the samples.

Two dates were sampled in 2007. **Figure B-8** shows the location of the sampling locations. **Table B-10** shows the results. No observed *Enterococci* concentration was above 104 cfu/100 ml, and no OB measurement was above 70.

Quantitative data from 2008 are unavailable. VT (2008) states that "...there were no major sources of wildlife in the preserve that appeared to be capable of impacting water quality at the beach."

Figure B-8. Sampling locations near Caledon State Park, 2007.

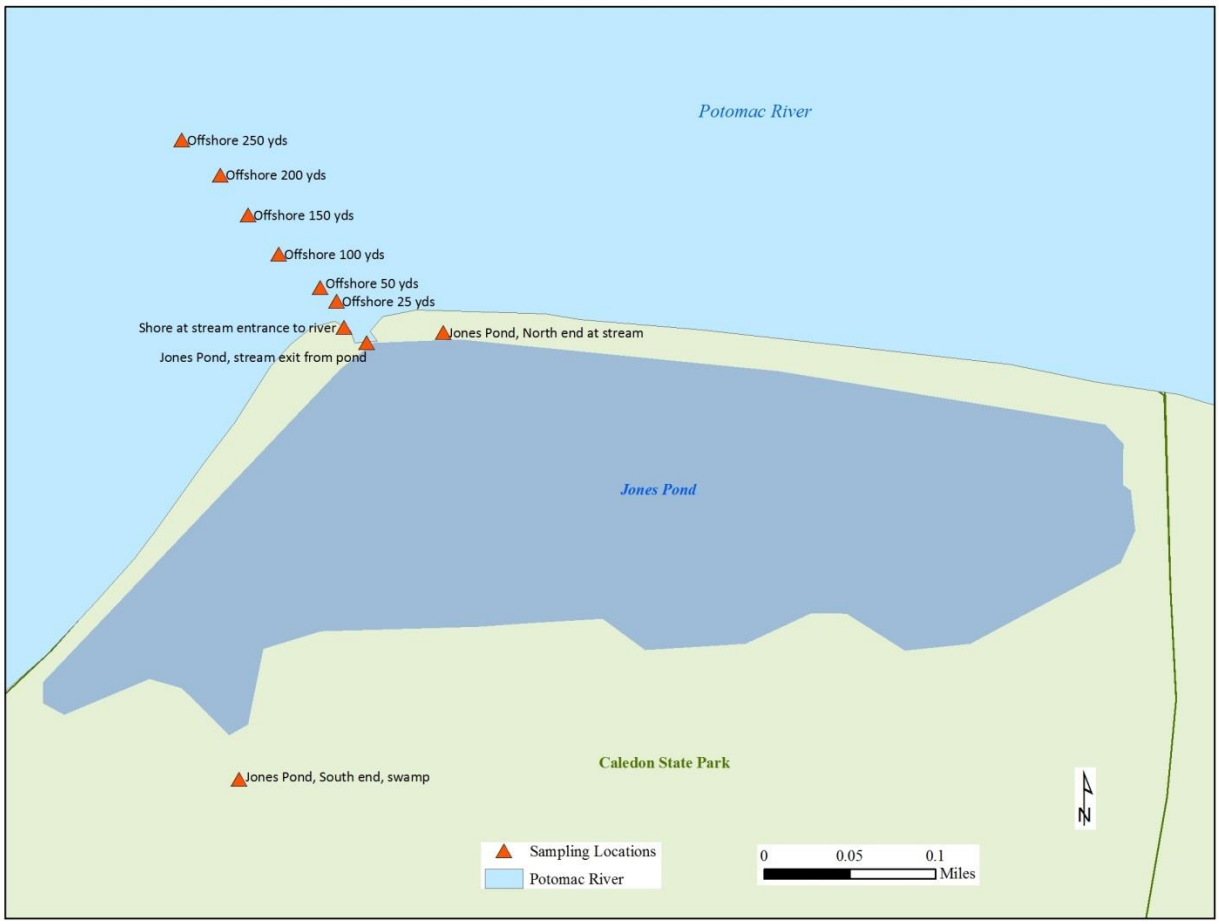


Table B-10. VT sample results in Caledon Natural Area State Park, 2007.

Location	7/17/2007		9/3/2007	
	Enterococci (cfu/100 ml)	Optical Brighteners	*Enterococci* (cfu/100 ml)	Optical Brighteners
Offshore 250 yards	<10	41	34	36
Offshore 200 yards	45	40	83	21
Offshore 150 yards	52	26	<10	37
Offshore 100 yards	68	42	48	40
Offshore 50 yards	<10	22	<10	21
Offshore 25 yards	53	35	73	31
Shore at stream entrance to river	<10	24	56	46
Jones Pond, stream exit from pond	45	39	68	25
Jones Pond, South end, swamp	74	20	102	17
Jones Pond, North end at stream	58	70	73	33

B.2.6 Marina and Boating Events

VT staff took samples 50 yards north and south of the marina of the Fairview Beach Yacht Club in 2004. A single isolate was attributed to human sources at the south sampling location, while no isolate

was attributed to human sources at the north sampling location. OB measurements were 41.1 and 41.5 at the north and south sites, respectively. The samples were not analyzed for bacteria concentrations.

In 2007 and 2008, VT staff sampled for bacteria and OBs in and around an event at Fairview Beach that attracted a large number of boaters. The 2007 event occurred on Labor Day weekend. **Table B-11** shows that despite the presence of as many as 70 boats over the weekend, *Enterococci* concentrations and OB measurements remained low. Over the same weekend at one VDH sampling site on 9/2/2007, a concentration of 135 cfu/100 ml was observed but the average value of all three VDH sites was below 104 cfu/100 ml.

Table B-11. VT monitoring results of labor day weekend (2007) boating event at Fairview Beach.

	9/2/2007 (20-30 boats)		9/3/2007 (50-70 boats)		9/4/2007 (no boats)	
Location	*Enterococci* (cfu/100 ml)	Optical Brighteners	*Enterococci* (cfu/100 ml)	Optical Brighteners	*Enterococci* (cfu/100 ml)	Optical Brighteners
Down river – below boats	43	22	85	20	20	19
Beyond boats in main channel	<10	20	<10	21	<10	20
Up river – beyond boats	35	40	30	38	15	30
In front of stage	54	35	102	43	38	37

In 2008, VT staff sampled for bacteria during an even larger event, attended by hundreds of boats. VT (2008) did not report the quantitative results from their sampling of this event, but they did state that "[t]he impact of weekend crowds and boaters was not a problem."

B.3 FBRA Monitoring Results

Starting in 2011, the FBRA worked with the DEQ to perform bacteria monitoring using Coliscan kits provided by DEQ. Coliscan kits provide an inexpensive way of testing for *E. coli* bacteria. This testing method sufficiently indicates the presence and concentration of *E. coli* bacteria that may be present; however, the data may have variations in quality assurance and is not used quantitatively to list/delist waterbodies on the impaired waters list. The *E. coli* freshwater assessment threshold of 235 cfu/100 ml, which is used for assessing waterbodies when there are not enough samples to calculate a geometric mean, is roughly equivalent to the 104 cfu/100 ml for *Enterococci*. *E. coli* die off more rapidly in salt water, so the Coliscan results may underestimate the equivalent *Enterococci* concentration. FBRA has kept DEQ informed of the results of their monitoring; DEQ provided training in the use of the Coliscan kits and continue to provide advice to the FBRA volunteers.

FBRA monitoring has primarily focused on three issues: 1) the level of bacteria in local runoff, 2) elevation of bacteria concentrations under agitated conditions, and 3) potential sources of bacteria in the vicinity of the Pavilion Street drainpipe.

B.3.1 Bacteria in Local Runoff

FBRA collected samples at multiple locations along eleven streams, drainpipes, and ditches where stormwater runoff could potentially impact the beach. **Figure B-9** shows the location of the monitoring locations. **Table B-12** shows the *E. coli* concentrations observed using the Coliscan kits. **Figure B-10** shows the observed concentrations by rainfall. As FBRA reported (Cover et al. 2011), there

were practically no bacteria in these locations if there had been no rainfall, but there were significant concentrations of bacteria after rainfall events. Nineteen samples were taken at these locations after 1.3 inches of rain fell on July 8, and only one of the samples had a concentration less than 900 cfu/100 ml.

Figure B-9. FBRA stormwater sampling locations.

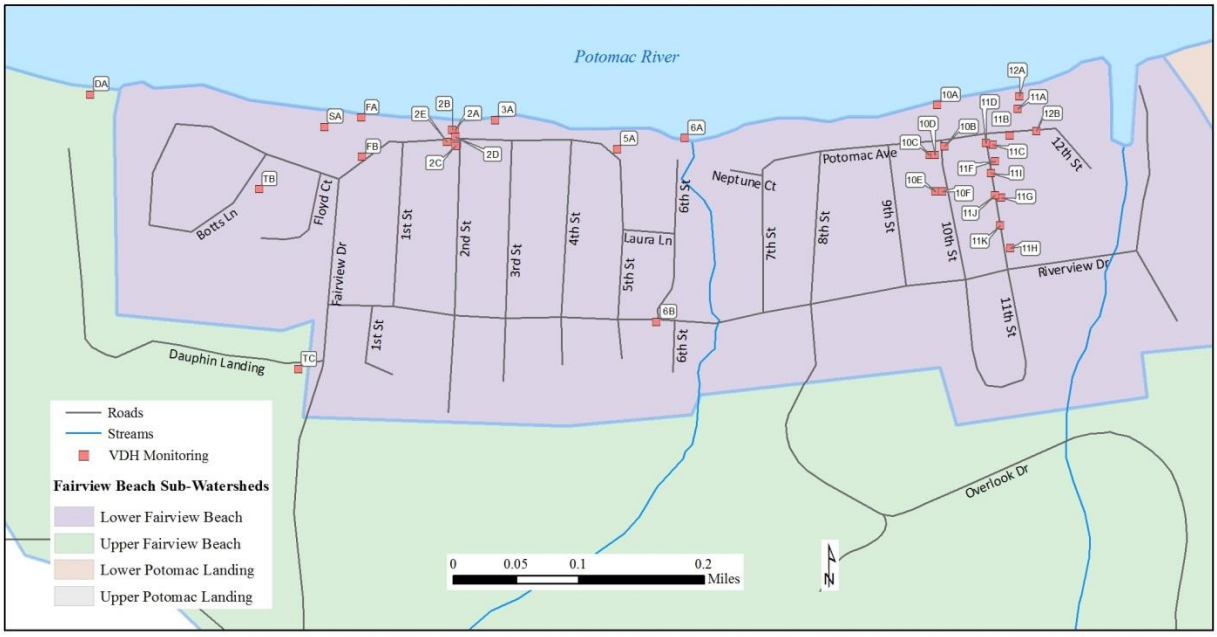
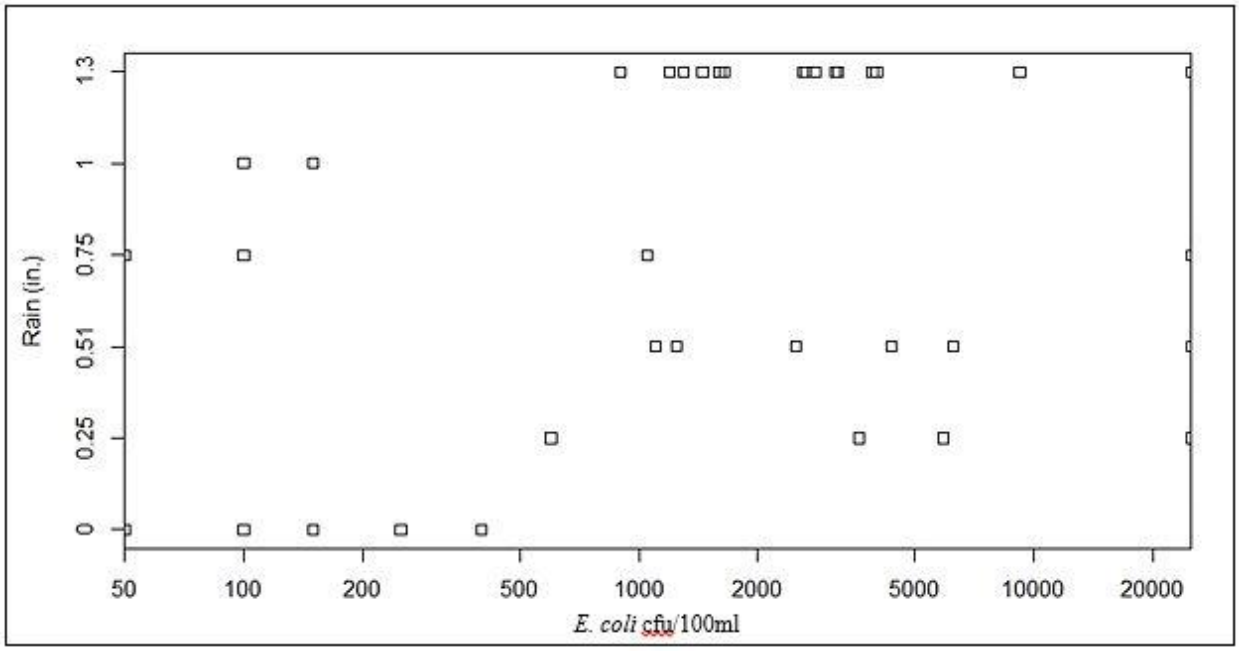


Table B-12. Observed *E. coli* concentrations (cfu/100 ml), FBRA storm sampling.

Date	6/20/2011	6/25/2011	6/28/2011	6/29/2011	7/3/2011	7/8/2011	7/13/2011
Rain (inches)	1.0	0.0	0.0	0.75	0.25	1.3	0.51
2A		<100		<100	5,900	1,450	
2B							
2C						1,200	
2D						1,300	
2E						900	
3A		<100		<100			
5A		400	250	100		4,000	
6A		100		1,050			
6B					600		
10A		<100		<100			
10B						3,900	
10C						4,000	
10D						1,650	
10E							TNTC
10F							TNTC
11A				TNTC		3,200	>5,000
11B					TNTC	2,600	
11C						TNTC	

Date	6/20/2011	6/25/2011	6/28/2011	6/29/2011	7/3/2011	7/8/2011	7/13/2011
Rain (inches)	1.0	0.0	0.0	0.75	0.25	1.3	0.51
11D						2,650	
11E						3,150	
11F							6,250
11G							>5,000
11H							1,250
11I							TNTC
11J							>5,000
11K							1,100
12A						2,800	
12B							4,350
DA		150		100		1,300	
FA		<100				4,000	
FB		<100					
SA				<100		9,200	
TB	100			<100	3,600		
TC	150					1,600	

Figure B-10. FBRA stormwater bacteria monitoring results.



B.3.2 Elevated Bacteria Concentrations under Rough or Muddy Conditions

VT (2005 and 2006) observed that precipitation events often triggered elevated bacteria concentrations and VT (2007) entertained the hypothesis that bacteria re-suspension under the action of wind, waves, or tides could contribute to high bacteria concentrations. Cover et al. (2011) report that "[a] former VDH employee once told us that he could almost forecast high bacteria readings based on the

sight of the river (p. 4)." If the river was muddy or turbulent, the bacteria concentrations could be expected to be high.

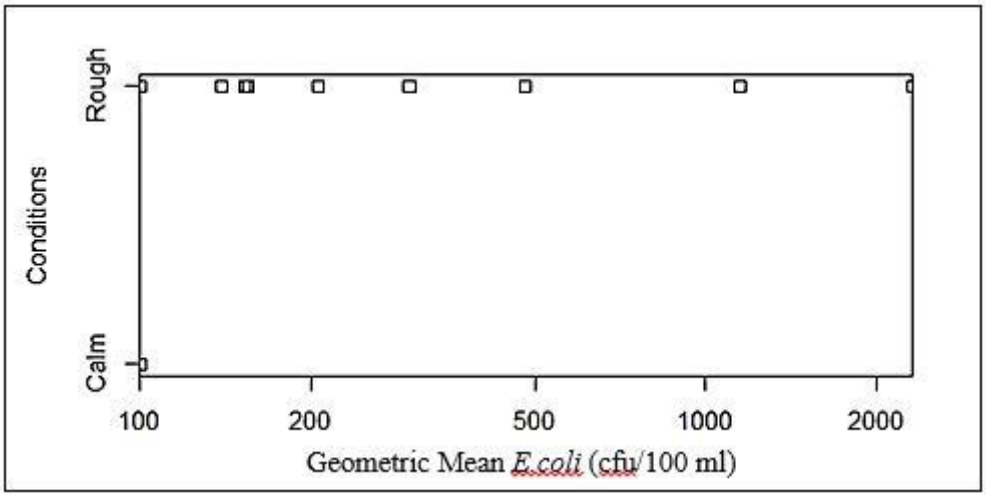
FBRA sampled on several occasions to test the hypothesis that elevated bacteria concentrations occurred primarily under rough or muddy conditions. **Table B-13** summarizes the mean *E. coli* concentrations observed in the Potomac River under calm and rough conditions. **Figure B-11** contrasts observed bacteria concentrations under calm and rough conditions (calm observations lie on top of each other at 100 cfu/100 ml.). Bacteria concentrations were low, either at or below the detection limit, in samples taken from the Potomac River under calm conditions. Although elevated concentrations were not always observed when conditions were rough, concentrations exceeding the 235 cfu/100 ml assessment threshold occurred only under rough or muddy conditions.

On the other hand, when FBRA monitors collected a sediment sample and placed it in distilled water, they were not able to observed high bacteria concentrations when they agitated the sediment.

Table B-13. Average *E. coli* concentrations (cfu/100 ml) in calm vs. rough conditions.

Date	Conditions	Number of Samples	Arithmetic Mean	Geometric Mean
7/18/2011	Calm	7	100	100
8/4/2011	Right after rain	5	100	100
9/10/2011	Muddy 100-140 ft., wavy	12	163	153
9/15/2011	Muddy, whitecaps	11	177	139
9/18/2011	Muddy, wavy, trash	3	483	479
12/18/2011	Rough, choppy	3	100	100
3/23/2012	Calm	3	100	100
3/28/2012	Calm	3	100	100
4/3/2012	Calm	3	100	100
5/10/2012	12" cap muddy	3	100	100
5/25/2012	Calm	3	100	100
5/26/2012	Low tide, very rough water	6	1,267	1,150
8/18/2012	Pounding waves	5	2,540	2,320
9/10/2012	White caps, 1 foot waves	5	170	155
9/15/2012	1 foot caps	6	308	299
9/22/2012	Calm	3	100	100
9/30/2012	Calm	2	100	100
10/6/2012	River had been rough	5	220	206

Figure B-11. FBRA bacteria monitoring results under calm vs. rough conditions.



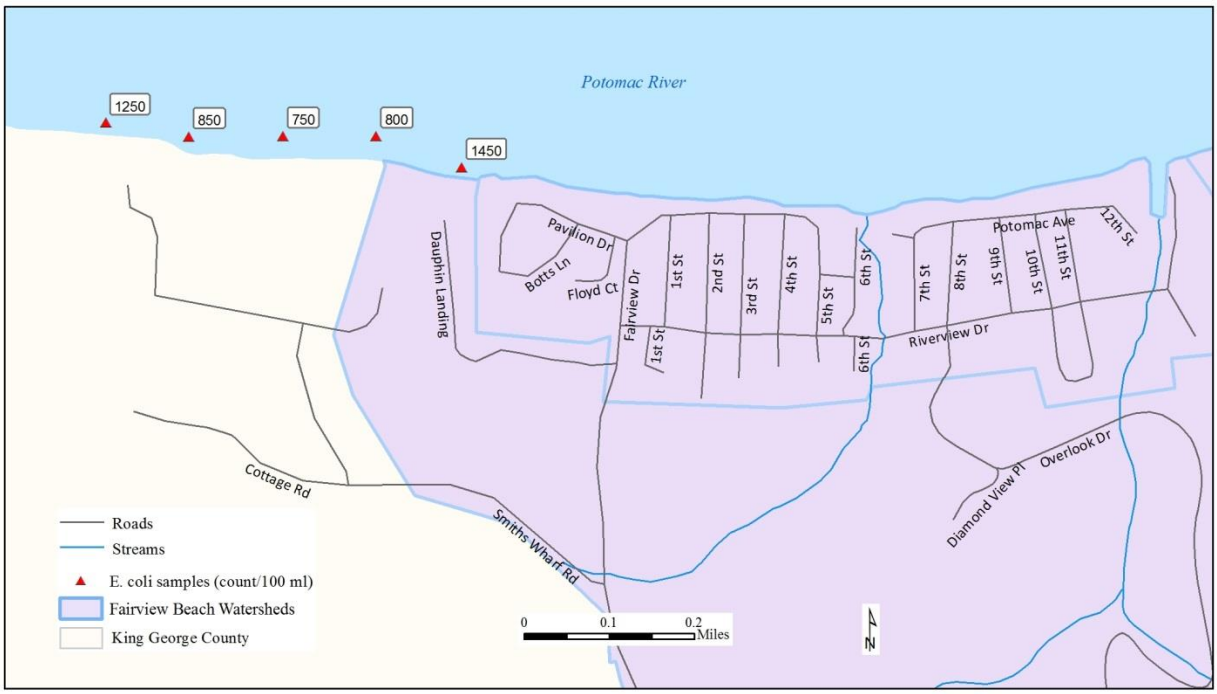
In 2011, FBRA volunteers took paired samples from five locations 1) waist-deep and 2) shoulder-deep in the Potomac under choppy conditions. **Table B-14** shows the results. The waist-deep samples had *E. coli* concentrations between 200 and 250 cfu/100 ml, while samples taken farther out (shoulder-deep) generally had no detectable concentrations. This confirms the results of VT's paired sampling, which also found bacteria concentrations to be higher near shore.

Table B-14. *E. coli* concentrations (cfu/100 ml) at paired sampling sites in the Potomac River, FBRA sampling, 2011.

	9/10/2011		9/15/2011	
Location	waist-deep	farther out	waist-deep	farther out
VDH-C	250	150	600	<100
5th Street	250	100	100	<100
8th Street	150	150	400	<100
11th Street	200	100	<100	150
DA (see **Figure B-9**)	200	<100		<100
VDH-B	200	<100	<100	<100

FBRA volunteers also sampled for *E. coli* near shore at five locations over a half a mile upriver from Fairview Beach under rough conditions. As shown in **Figure B-12**, observed concentrations ranged from 750 to 1450 cfu/100 ml. The observation of elevated concentrations under rough conditions up to a half of a mile upriver from Fairview Beach may indicate that a more general mechanism may be responsible for the elevated bacteria concentrations observed at the beach.

Figure B-12. *E. coli* concentrations observed under rough conditions upriver from Fairview Beach, 5/26/2012.



B.3.3 Parking Lot Drainage and Subsurface Sampling

In 2012, the parking lot off Pavilion Drive at the foot of Botts Lane was embanked, and a twelve inch black corrugated pipe was installed to carry runoff approximately 40 ft. to the Potomac River, adjacent to the swimming area. Prior to the installation of the pipe, runoff from the parking lot would frequently erode the beach (personal communication, Cover et al., 8/22/2012).

FBRA volunteers sampled standing water in the parking lot after a small amount of rain. The *E. coli* concentration was estimated to be greater than 5,000 cfu/100 ml. The *E. coli* concentration detected in subsequent sampling from the water found about 15 inches below the sand surface near the pipe outlet was also greater than 5,000 cfu/100 ml, while a subsurface sample taken in the vicinity of VDH Site A detected no *E. coli* bacteria.

FBRA volunteers took six additional samples from runoff in the parking lot during a 20 minute storm in which 0.75 inches of rain fell. Two samples from runoff at the periphery of the parking lot had elevated concentrations, 900 cfu/100 ml and TNTC, but at the point where the runoff entered the black corrugated pipe the *E. coli* concentration was 150 cfu/100 ml. This suggested that parking lot runoff was not the source of the elevated bacteria concentrations observed in the subsurface sample at the end of the pipe.

About a dozen additional subsurface samples were taken in the vicinity of the end of the black corrugated pipe, on the theory that there was a sewer leak somewhere near where the pipe discharged to the Potomac River. Elevated concentrations, ranging from 700 to greater than 5,000 cfu/100 ml, were measured within 4 ft. of the outfall, but at greater distances, the concentrations tended to be below the detection limit. A pipe from a urinal was later found to be the cause of the elevated counts. The pipe had been discarded when the rest rooms were refurbished. Testing results showed negligible bacteria after removal of the pipe. (personal communication, H. Cover, 7/16/2014).

B.4 November 18, 2013 Sampling

On November 18, 2013, VDH and VT personnel collected water samples at eleven sites along the beach and sediment samples at seven sites along the beach and eight sites along two intermittent streams draining to the beach. A water sample was also taken from a standing water near the near the Pavilion Drive drainpipe and the pumping station. **Figure B-13** shows the location of the sampling sites. The sampling occurred within twelve hours of a rain storm and the goal of the sampling was to help determine the impact of stormwater on bacteria concentrations at the beach. In addition to measuring *Enterococci* concentrations in water and sediment, OBs were measured in water samples. Genetic testing was performed at the VT lab on both water and sediment samples to detect two DNA markers indicating the presence of fecal bacteria. The first marker, GenBac, is the general Bateriodes indicator of fecal pollution, while the second marker, HF183, indicates the presence of bacteria from human sources.

Figure B-13. November 18, 2013 sampling locations.

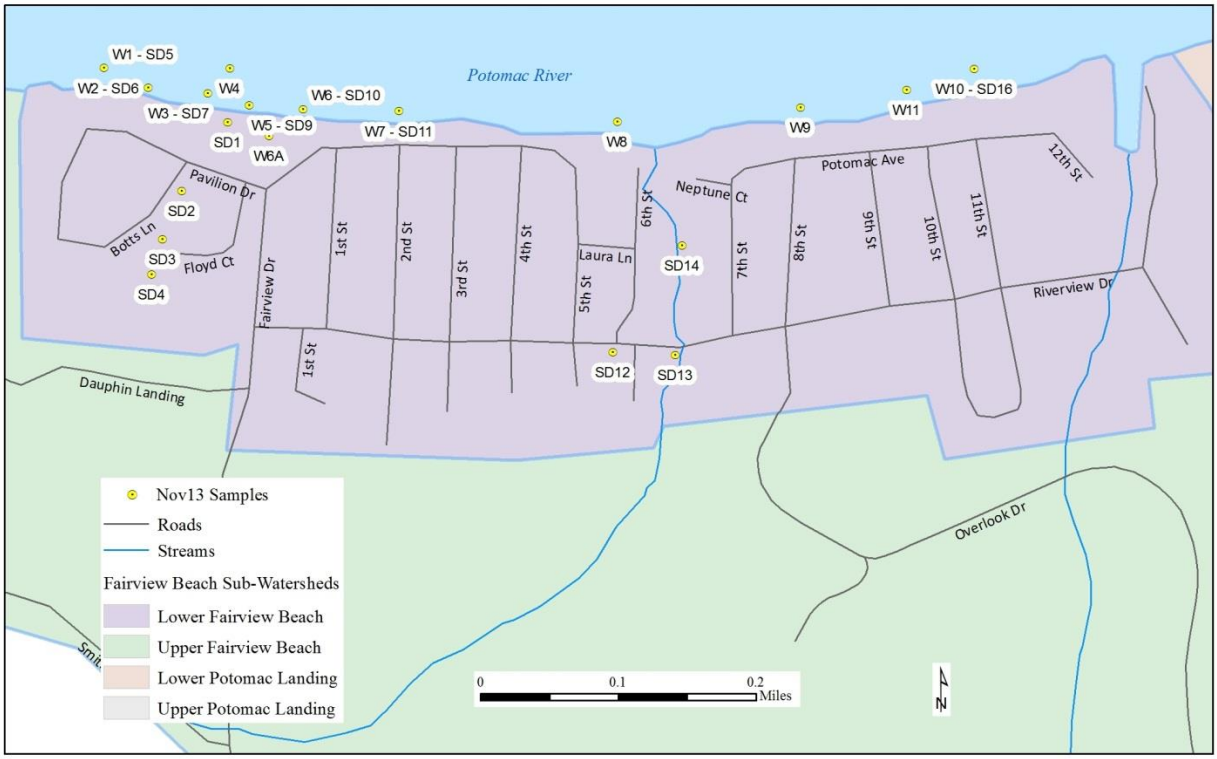


Table B-15 summarizes the results. Meteorological conditions at the time the sampling occurred were relatively calm. At all but one sampling site along the beach, bacteria concentrations in both water and sediment were low, OB measurements did not indicate any human sources, and the tests for HF183 were negative. However, at sampling location W8, along the beach closest to the intermittent stream along 6th Street, the *Enterococci* concentration was 880 cfu/100 ml, and both genetic testing and OB measurements indicated a human source of pollution. Sediment samples from the intermittent stream along 6th Street had bacteria concentrations ranging from 800 to 3,050 cfu/100 ml and all samples tests positive for the HF183 marker, suggesting that stormflow from the 6th Street stream could be responsible

for not just the high bacteria concentrations observed at W8 but also the human sources of bacteria pollution observed there.

Table B-15. November 18, 2013 sampling results.

Medium	Description	Sites	*Enterococci* (cfu/100 ml)	OBs	HF183
Water	20 ft. off-shore	10	< 27	< 35	-
Sediment	20 ft. off-shore	7	<60	N/A	-
Sediment	Pavilion Drive drainage	4	1,460-6,000	N/A	N/A
Water	Stagnant pool near pumping station	1	2,200	98.2	+
Sediment	6th Street drainage	4	800-3,050	N/A	+
Water	20 ft. off-shore (6th Street)	1	830	88.1	+

Sediment samples from the intermittent stream above Pavilion Drive also had high bacteria concentrations, ranging from 1,400 to 6,300 cfu/100 ml. These samples were too dry to perform genetic testing on, but OB measurements previously had indicated the presence of human sources (see **Section B.2.3**). The standing water near the Pavilion Drive drainpipe has the highest bacteria concentration (2,200 cfu/100 ml) of any water sample. OB measurements and testing for HF183 also indicated that human sources were contributing to the high bacteria concentrations at this location. It was not determined where the water at this location comes from, so its relation to the stream or the drainpipe, previously identified as a bacteria hotspot (see **Section B.2.3**), is unclear.

To summarize, sampling on November 18 supports the following conclusions:

1. Storm water and sediment in intermittent stream can be a significant source of the bacteria observed at Fairview Beach;
2. Human sources of bacteria are still contributing to the bacteria observed at Fairview Beach; and
3. Human sources of bacteria are not confined to the trailer park or the area around the drainpipe at Pavilion Drive.

B.5 Summary of Monitoring Results

The following conclusions can be drawn from the bacteria monitoring performed by VDH, VT, and FBRA:

1. Bacteria concentrations are elevated when river conditions are turbulent, muddy, choppy, or otherwise rough;
2. Bacteria concentrations under turbid or rough conditions tend to decrease moving away from the shoreline, indicating the direct source of bacteria under rough conditions is not the Potomac River;
3. Elevated bacteria concentrations under turbid or rough conditions may not be a problem confined to Fairview Beach;
4. Bacteria concentrations in the Potomac River outside the vicinity of Fairview Beach are generally lower than the concentrations observed at Fairview Beach;
5. Elevated concentrations of bacteria are observed in local stormwater draining Fairview Beach;
6. Although several human sources of bacteria have been identified and rectified, local human sources continue to contribute to the bacteria observed at Fairview Beach; and

7. Eliminating bacteria just from human sources and pets may not be sufficient to fully resolve the bacteria impairment at Fairview Beach.

Appendix C 2014 VDH Monitoring Data for Fairview Beach

2014 Beach Monitoring Data for Virginia

Notes: The water quality standard is 104 cfu/100ml; average enterococcus group bacteria counts above 104 cfu/100ml result in a swimming advisory
A value of 1 is substituted for values reported as <10 or <20 for the purpose of calculating averages.
Averages are rounded to the nearest whole number

Rappahannock

Beach Name	Sampling Date	Sampling Location 1	Sampling Location 2	Sampling Location 3	Sampling Location 4	Average	Swimming Status
FAIRVIEW BEACH	05/19/2014	308	276	264		283	Swimming Advisory
	05/21/2014	48	28	60		45	Open
	05/27/2014	68	88	44		67	Open
	06/02/2014	32	44	38	74	47	Open
	06/09/2014	96	68	160	100	106	Swimming Advisory
	06/11/2014	TNTC	TNTC	TNTC	TNTC	24191	Swimming Advisory
	06/16/2014	152	110	122	88	118	Swimming Advisory
	06/18/2014	22	20	26	26	24	Open
	06/23/2014	184	176	106	90	139	Swimming Advisory
	06/25/2014	20	20	12	10	16	Open
	06/30/2014	72	18	26	48	41	Open
	07/07/2014	12	96	TNTC	TNTC	12123	Swimming Advisory

5/19 Night turbidity, flood conditions, 1' swells
6/8 Calm, rain event within 24 hours
6/11 Waves 1/2 to 1', samples cloudy, breezy, storms within past 2 hours
6/16 Extremely high tide (samples taken 20' offshore vs. usual 40') samples clear, dead fish noticed, No rain within past 24 hours
* 6/23 low tide, calm, samples clear, no rain within 24 hours
* 7/7 low tide, slight chop, samples clear, breezy 3 days past hurricane